JUNE 1980
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Hi-Fi: Feature: Music & acoustics

Reviews: Kenwood 'high speed' amp an[illegible] NS344 speakers

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UD: 60, 90, 120 min./LN: 60, 90, 120 min.

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A RATHER UNUSUAL story came to our attention when we were preparing this issue. An acquaintance of staff member Elaine Ray is involved in the manufacture of metalworking machines — specifically, press brakes which are used to bend sheet metal into a desired form. These machines are motor driven and operated by a skilled sheet metal worker. Elaine's acquaintance mentioned, in passing conversation, that the "magic chip" had invaded his industry of recent. Upon investigation, there was more of a story in this than first met the eye.

Almost since their inception, these machines have been set up mechanically, to do one bend at a time, a job involving large numbers of a particular product having several different bends involved would proceed on a batch basis. That is, all the right angle bends could be done first, followed by the shallow bends etc. The machine would have to be manually set up between each batch of bends. Recently, however, microprocessor controllers appeared enabling these machines to be "programmed" so that bends of differing angles could be made in series allowing the operator to commence with 'raw' plate and produce the finished product in one go.

The upshot is improved job throughout (and thus improved efficiency, etc), less machine downtime for setting up and no encroachment on the operators' skill — an important human factor.

However, the microprocessor controllers, it seems, have to be imported. The question raised with us was, why couldn't they be made here — to meet the specific needs of the industry in Australia? The expertise certainly exists here, perhaps even the entrepreneurial drive. So what's happening? The industrial electronics/micro applications industry is not active, or active enough perhaps, in seeking other industries where their expertise can be of assistance. The micro industry seems somewhat too inward-looking for its own health.

Look around fellas, there's work to be found!

(Full story in Printout on page 95).

Roger Harrison
Editor

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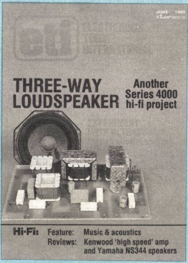

JUNE 1980
eti
THREE-WAY LOUDSPEAKER
Another Series 4000 hi-fi project
Hi-Fi: Feature: Music & acoustics
Reviews: Kenwood 'high speed' amp and Yamaha NS344 speakers

COVER

The prototype crossover network for our Series 4000/2 three-way loudspeaker project and a spare driver from Philips' latest range of speakers serves to introduce this month's feature project. Another Ivy Hansen photocomposition fantasia — like last month's cover (one day soon we'll tell you how it was done, for all those that enquired).

news

NEWS DIGEST 8
"Pay-TV" coming?; Intelsat moves; Video disc player for 1981 release?; Looking for a CRO?; Hatched/matched/despatched, etc.

PRINTOUT 95
Micros invade the machine shop; Protect your micro; New magazine; Solid-state recorder a first.

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New programmable scanner has many features; Review of CB radio policy; New analyser.

SHORTWAVE LOGGINGS 111
Time to hear the Latin Rhythms!' Zimbabwe reorganised; Indonesian college; Iran shifts.

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THE SPACE TELESCOPE 1
To be launched in 1983, this orbiting observato will provide a better view of the heavens than can b seen from earth.

BUDGET RECEIVERS FOR THE SW ENTHUSIAST 2
Eavesdropping on the world need not be a expensive hobby.

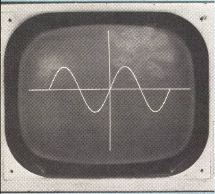
EXPERIMENTING WITH ULTRASONICS 3
You can build a fascinating array of gadgets usin inexpensive transducers.

THE MINI-MAP MICRO
A locally designed and manufactured machin targeted for the classroom.

projects

497: SERIES 4000 THREE-WAY LOUDSPEAKER 5
Second in our line of quality hi-fi loudspeake projects designed and developed in our ow laboratory, this model will provide excellent sound a a price to suit the average constructor.

578: NICAD CHARGER 59
Keep your rechargable batteries in tip-top condition.



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New speaker drivers; 'Super' portables; Protect your discs; Car stereo with e-q and Dolby!

MUSIC & ACOUSTICS 125
Why do orchestras, bands etc sound different in different venues? John Gardner explains.

KENWOOD KA701 AMP 136
A high speed, dc integrated amp. But, does a 400 kHz bandwidth matter?

WHARFEDALE E70 SPEAKERS 150
This four-way system, according to Louis Challis, "... is, without doubt, the best Wharfedale system I have yet heard ...".

YAMAHA NS344 SPEAKERS 144
A three-way system of almost bookshelf size. "... distortion figures ... are particularly low and round off a set of objective tests which are ... excellent".

AMPEX CASSETTE OFFER 104
Superb offer of Ampex' "professional" series cassettes — only through ETI.

REEL-TO-REEL TAPE OFFER 1555

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Plenty of circuits to play with here.

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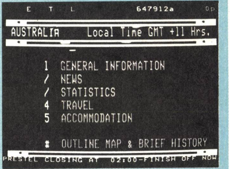

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VIEWDATA!

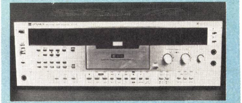
The telephone and the television changed people's lives. Combine the two and it's sure to happen all over again. Les Bell reports on "the interactive Teletext".

BUILD A LASER!

That's right, you can build your own laser. It's a fascinating device, you can perform all sorts of experiments, create a magic light show, make a laser communicator ...

NICAD *FAST* CHARGER

It's embarrassing to be caught with flat batteries in your flash at your sister's wedding, isn't it ? Well, it's moments like these you need . . . the ETI fast NiCad charger!



OPTONICA RT-7100 CASSETTE DECK

It's more of an electronic tape processor than your common-or-garden variety cassette deck.

TURNTABLE TECHNOLOGY

Designers have been paying a lot of attention to the turntable system over the past decade and some remarkable technology is appearing as a result.

Although these articles are in an advanced state of preparation, circumstances may affect the final content. However, we will make every attempt to include all features mentioned here.

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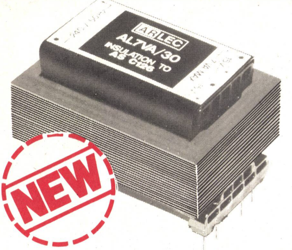

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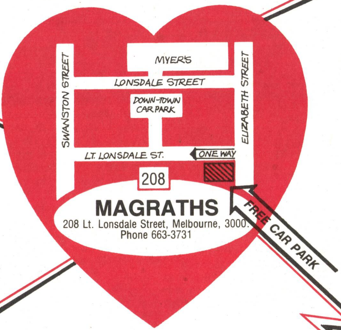

IN THE HEART OF MELBOURNE

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"Pay-TV" coming?

The office of the Minister for Post and Telecommunications says that the Minister, Mr Tony Staley, will shortly make a statement on the introduction of "Pay-TV" into Australia.

Subscribers pay for a system to be connected and programmes are 'piped' to their house via a cable. The system allows the user to choose from a wide variety of programes with no advertising as the subscriptions pay for the production costs.

It is hoped that Pay-TV could begin by 1981.

The incoming Chairman of the Australian Broadcasting Tribunal, Mr David Jones, will be faced with the responsibility of making recommendations to Parliament when he takes up his appointment in July.

Mr Staley is very keen that a decision should be made as soon as possible since the enormously increased choice would deflate criticism of the present monopoly control of Australian media, he says.

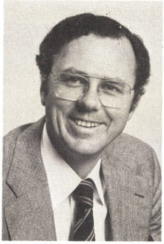
The introduction of Pay-TV would be a complicated process since decisions on factors such as organisation, control, financing, and technology would have to be made.

The technological problem concerns whether or not to use fibre optic cables to distribute programmes and data.

The large bandwidth available with fibre optics would enable some 150 different channels to be accessible.

Some areas of Los Angeles in the US have 75 channels to choose from, which means that minority interests, two-way communication links, TV newspapers, computer data, video books etc are possible.

The political and economic considerations are obviously very important, especially since such a cable system would cost several billion dollars when installed country-wide. A study of the implications should be initiated as soon as possible, says Mr Staley.



P & T Minister, Mr Tony Staley.

Super op-amp

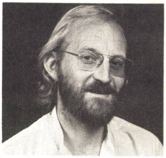
National Semiconductor has introduced a new monolithic operational amplifier that they claim dramatically advances the state of the art for precision dc amplifiers.

Designated the LM11, this op amp challenges the low bias currents of FET-input devices, even at room temperature.

"When considering offset voltage, long term stability or operation at elevated temperature, FETs are totally outclassed by the LM11," said Ed Schoell, NS Electronics Applications Engineering manager.

"With a 0.3V/us slew rate, the LM11 is not fast, but its speed is offset by its low 300uA supply current. Nonetheless, the LM11 can be teamed with existing fast amplifiers to take advantage of the best characteristics of both, even in voltage follower applications," said Schoell.

Full details and application notes available from NS Electronics, P.O. Box 89, Bayswater Vic. 3153. (03) 729-6333.



New faces at ETI!

Two new personalities have joined the good ship 'Etty' and all you good readers and advertisers will be hearing/seeing more from them in the future.

First up is **Elaine Ray**, who has joined our advertising sales staff in Sydney. Elaine comes to us from Gundagai (where the dog . . .) via Sydney University where she obtained a B.Sc. (Hons.) in Physics in 1969. She followed this rapidly with a Dip. Ed. from Alexander Mackie College in 1970. From there Elaine enjoyed a distinguished career teaching at a string of distinguished and undistinguished schools in Australia, UK and Switzerland. Mainly, she taught physics, chemistry, geography and woodwork.

Dr. John Pollard also joined us recently. John was educated at Oxford University, UK, gaining his B.A. (Hons.) in Natural Science, Physics, at Oxford in 1963, followed by an honorary M.A. in 1966. In 1968, John was awarded his Ph.D. for research in electronic materials from Southampton University. John was Associate Professor at the University of California Electrical Engineering Department for a while, teaching computing circuitry, digital electronics, memories etc and doing research in electronic materials. Along with several other people he set up the London Polytantric Institute and served as its Technical Director. Following that, he became the head of the Electrical Engineering Department of the University of Hun, Libya and later taught electronics in Barcelona in Spain, before coming to Australia last year.

John will be working on the editorial staff of ETI.

Intelsat drop prices, approve 'Arabsat'

Intelsat, the organisation which owns and operates the 10 satellite systems for global communications, has announced a 20% reduction in rates for leasing domestic communications capacity.

The price is now $8000 000 a year. Intelsat also have agreed to technical and economic co-ordination of a proposed "Arabsat" system for regional communications. This system will consist of two satellites in geosynchronous orbit to provide communications and TV within and between member countries.

A contract to investigate the effect of rain on communications above 10 GHz has been awarded by Intelsat to Ohio State University Foundation.

Rain clouds will be probed by radar beams and the intensity of the reflected beam will be compared to measurements of rain distribution in the area. The attenuation of signals from a satellite will also be noted simultaneously.

The study should help to determine how much extra power should be provided to compensate for rain effects and whether it would be helpful to provide two receiving stations a few miles apart so the station with best reception would be used for communications during local rain storms.

Looking for a CRO?

It isn't easy to choose an oscilloscope once you've made the decision to buy — the main problem is defining your application versus the price you can afford.

Half a dozen recently-released oscilloscopes illustrate the point.

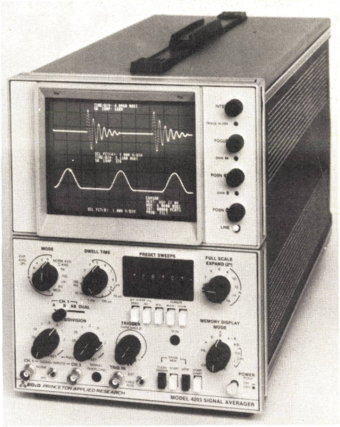
The Farnell Instruments Model DT 12/5, marketed here by Warbuton O'Donnell, is a tough, portable instrument for field use, lab or test bench. The makers claim a vertical bandwidth of 12 MHz and sensitivity of 5 mV/cm. It's a dual-trace machine with signal-derived triggering. Priced at $835 it should find its way into many a service shop or department. Want to know more? — phone (02) 407-3261.

As the price goes up, so does the power of the 'scope. The new BS615 from Elmeasco is a dual-trace instrument having a specified bandwidth of 40 MHz. Vertical deflection ranges start at 5 mV/cm and progress to 20 V/cm. You can run five display modes: channel A or B, dual, add and chop, which is pretty standard for most dual-trace instruments. The maximum rise time claimed is 9 ns and the unit will set you back $990. Interested ? Call Elmeasco on (02) 736-2888.

Looking at the Hitachi Denshi V550, distributed by Standard Components, this dual-trace CRO costs $1615 but you get things like: 50 MHz bandwidth, displayed trigger with variable "hold off" and a delayed sweep which allows magnification of any portion of the display by as much as 1000 times. Sensitivity, attenuator ranges and operating modes are much the same as the BS615. Standard Components will extol its virtues if you ring them on (02)660-6066.

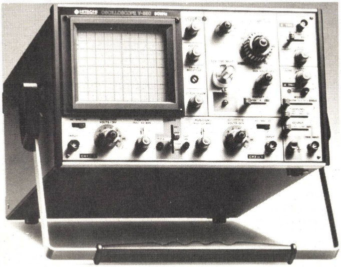
At the top end of the range is a 'signal averager' introduced by Princeton Applied Research and distributed by Tecnico Electronics. This Model 4203 costs only $12 500 and is a very sophisticated oscilloscope indeed.

Repeated waveforms in noisy backgrounds can be observed and the waveforms' information processed by an internal microprocessor. The signal to noise ratio can be impoved by exponential linear summation, or normalized averaging as appropriate. The maximum frequency of signals which can be processed and displayed is 10 MHz. An optional interface pushes this to around 50 MHz. It displays critical information such as pulse rise and fall times, the measured area under any segment and delay times between pulses. Many interface options are possible. For instance, remote control, X-Y recording etc, and it does everything but talk to you! Further information from Tecnico on (02)427-0888.



You'll pay top money for an oscilloscope like this — the Model 4203 'Signal Averager' from Princeton Applied Research. With this instrument you can 'pull' signals out of noise and perform several types of averaging operations on an input signal. Talk to Technica

Hitachi's V550 is a dual-trace instrument featuring 50 MHz bandwidth and delayed sweep. Hitachi CROs are handled by Standard Components



Going 'down market' local manufacturer, BWD, released their model 804 in April and they claim this single-beam unit has many features that make it a high class measuring instrument. Bandwidth is specified as dc — 10 MHz and the large 80 x 100 mm display makes it an ideal instrument for educational use. The X, Y and Z inputs are all dc coupled, the latter being TTL-compatible. It would be well suited to any usual CRO applications in audio, industrial and servicing fields and BWD point out that it would make an excellent X-Y-Z monitor for analogue or digital displays. Full details from BWD on (03)561-2888.

For the bargain basement hunter, you could well do worse than have a look at Dick Smith's "designed for Australia"CRO. This single-trace machine has a 75 mm screen, a sweep range of 10 Hz to 100 kHz and the bandwidth is quoted as dc — 5 MHz. Sensitivity is given as 10 mV per graticule division. It's light, portable and very basic but should be quite suitable for many service jobs or educational use. It's listed in Dick's latest catalogue as No. Q-1280 for ony $199. Enquire at any Dick Smith store.

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***DISCOUNT SHOPPING** for your professional Microcomputer and terminal requirements.*

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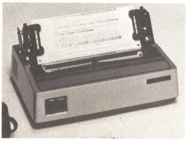
DISPLAY UNIT ex stock
From $1256 including tax.

Features: • 24 lines at 80 characters per line • Transmission rates 75 — 19,200 Bd. • 96 character ASCII upper and lower case • 12 inch monitor.



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Features: • 80 char/sec • 80 and 132 char/line • 9 x 7 dot matrix • Character or graphics printing • **Plug compatible to TRS-80.** ® Rgd. Tm.Tandy Corp.

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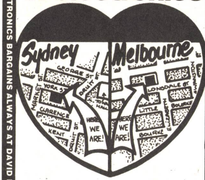

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MN9102
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Features
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- Simple to use
- Standard power supplies only (plus 5V, minus 12V)
- CMOS/TTL compatible
- 14-lead DIL package
- Typically ten million SAVE operations

Applications
• Metering systems • Elapsed time indicators • Security code storage • Last channel memory for digital tuning

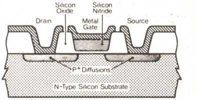
MN9102
The MN9102 is a non-volatile 4-bit data latch which uses MNOS* transistors as memory.

MN9105
The MN9105 is a 4-decade BCD counter which counts up or down on negative transitions of the Clock input. In parallel with the counter is a 16-bit non-volatile MNOS memory into which the contents of the counter can be written. When data has been written into the memory it can be retained in the absence of applied power, and subsequently be recalled from the memory to preset the counter.

MN9106
The MN9106 is a six-decade up counter in parallel with a twenty-four-bit MNOS memory which can provide non-volatile data storage of the current count position.

MN9107, MN9108
The MN9107 will count up to 99 hours, 59 minutes, 59 seconds, while the MN9108 counts up to 9999 hours, 59 minutes or 9999 minutes, 59 seconds.

APPLICATIONS
Applications for NOVOL are found in all forms of metering, security code storage, back-up storage for microprocessor-based systems, elapsed time indicators, electronic counters, latching relays and many other general industrial areas.



*NOVOL devices are produced using the Plessey Metal-Nitride-Oxide-Silicon (MNOS) process. MNOS transistors, as shown here in simplified form, are fabricated with a 'sandwich' structure gate dielectric consisting of a very thin layer of silicon oxide and a thicker layer of silicon nitride. In operation, a positive or negative charge injected (Written) into the nitride/oxide interface modifies the threshold voltage of the transistor. Since the injected charge is trapped within the bulk of the dielectric it is not affected by surface leakage and the difference between high and low thresholds can be detected (Read) over very long periods.

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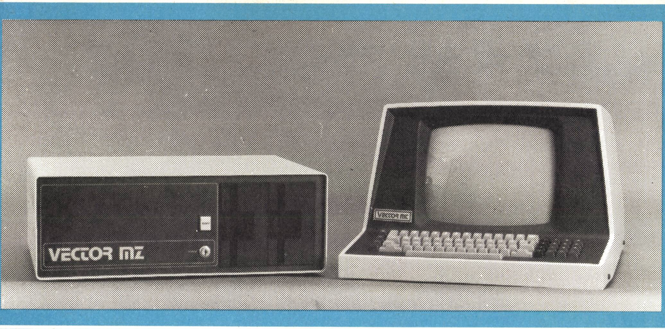

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VECTOR GRAPHIC is a leading American micro-computer manufacturer who has been producing reliable, quality products since 1976.

VECTOR GRAPHIC SYSTEM B offers enterprising companies the right hardware for the emerging micro-computer business market. More economical than "big" systems, yet offering wide ranging ability in their market sphere.

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- **48K or 64K RAM**
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NEWS digest

Fibre optic connectors for single fibres

One of the problems associated with fibre optics is the interconnection of two lengths of optical cable such that the connection is robust, stable, and optical losses are minimised.

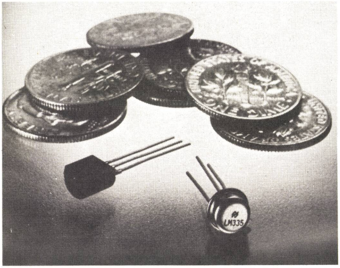
Radiall has developed a new connector which solves this problem.

Modern optical fibre is composed of a central core of fragile pure silica, a cladding of silicon, and a protective sheath of plastic. Connectors are first crimped to the end of the cable and the plastic sheath is stripped off, leaving the exposed fibre. A barrel assembly is then fitted over this fibre to protect it and hold it in position for a scribe-and-break operation to obtain a perfectly flat end-face, normal to the fibre axis.

The cable to be connected is prepared in the same way and the two barrel assemblies are attached to provide a strong mechanical assembly.

The optical faces of the fibres are now facing each other with a small gap between them. Radiall state that optical losses at the connection are less than 2 dB and connections can be made in less than two minutes.

Further information can be obtained from Warburton Franki, 199 Parramatta Rd, Auburn 2114 NSW.



IC temperature sensors

A new series of high performance IC temperature sensors, the first specified for use up to 200 degrees celsius, are now available from National Semiconductor Electronics.

The new monolithic device operates over a range of minus 55 to plus 200 degrees centigrade and is supplied with intial accuracies of plus/minus one, three or six degrees centigrade, but with the addition of a pot, all devices can easily be calibrated to better than plus/minus one degree.

The LM135 is available in a hermetic T0-46 package, while the commercial device, the LM335 is available in T0-46 or a T0-92 plastic package. The cost of the LM335 is 95 cents each for quantities over 100 and further information can be obtained from Ed Schoell in Victoria on (03) 729-6333, or from Chris Mason in NSW on (02) 93-0481.

Video disc player for 1981 release?

Philips plan to market their VLP laser pickup video disc in Australia early in 1981, hoping to gain about 10% of the colour TV market.

Projected price for the unit is "around $750" with hour-long discs to sell for about $6, while a three-disc movie album is tentatively priced at about $25.

'Software' will be sourced from the film giant MCA, with whom Philips signed agreements for developing the VLP system way back in 1974.

The Philips VLP features 30 minutes-per-side playing with 'standard' discs and 60 minutes-per-side playing with 'extended-play' discs; plus you get freeze-frame, fast-forward, reverse, variable speed forward and reverse and search playing modes (with standard-play discs only).

Four major Japanese companies have signed agreements with Philips and may market Philips-system VLP players. The firms are: Pioneer, Sony, Sharp and Trio-Kenwood.

However, it seems RCA and their Selectavision system, together with JVC and their VHD system, will provide strong competition in international markets. Undoubtedly we'll see examples of their systems on the market here, but whether the question of a common standard will be resolved — to prevent a likely repeat of the VCR standards debacle — remains a matter for speculation.

NEWS digest

New products from Datatel

Datatel Pty Ltd is the Australian representative of the Ailtech range of equipment and have announced the release of several new pieces of equipment.

One of these is a new 2 GHz signal generator, the Model 380, which is controlled by a microprocessor. Frequencies may be switched over any range of the 2000 MHz available in less than 20 microseconds and the instrument is capable of remote programming via a GPIB or IEEE-488 bus.

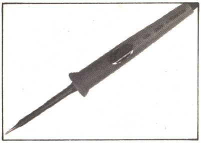
The spectrum analyser model 757 is usable over the range of 10 kHz to 22 GHz with sensitivity as low as -110 dBm and frequency dispersion may be set from 1 kHz to 700 MHz per division. Superior performance of the instrument is also provided by its high sensitivity of remote tuning and semi-automatic operation, say Datatel.

The last, but by no means least, is the model 13611 precision test receiver. This new IF test receiver is a valuable, general purpose, laboratory test tool which can be used for many applications requiring accurate and precise measurements of power level changes.

Further information as to prices and technical details can be obtained from Datatel Pty Ltd, 3 Raglan Street, South Melbourne Vic 3205. (03) 690-4000.

Ailtech's new Model 380 signal generator features a general purpose interface bus (GPIB) and 2 GHz range (top pic). Their new spectrum analyser, Model 757, goes to 22 GHz and a sensitivity of -110 dBm.

For precision soldering.
Light weight.
High power.



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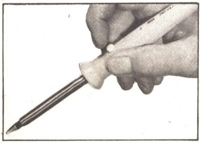

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SD-2B
ADCOLA

Hatched, matched, despatched

Brief news on company activities, new outlets, mergers, joint ventures and closures.

Hatched

•Dick Smith Electronics is opening two new stores this month — one in Sydney and one in Brisbane. Dick insists that this is not to make still more money but merely to provide a service to customers who would otherwise have to drive vast distances in their enthusiasm to buy kits and parts for ETI projects. The store in Brisbane is to be at 842 Gympie Rd, Chermside (phone 59-6970), north of the river, while the one in Sydney is to be at 613 Princes Highway, near the junction of King George's Rd in Blakehurst.

•Melbourne retailer, Abacus Computer Store, recently became the agents for Silicon Valley. Now you can get all those Silicon Valley goodies at a convenient inner-city location. You'll find Abacus at 512 Bridge Rd, Richmond.

Matched

•CSIRO has appointed a new chief of the Division of Applied Physics in the shape of Dr John Lowke, the internationally known Australian physicist.

The Chairman of CSIRO, Dr J Paul Wild, said that Dr Lowke would bring to the position invaluable experience relating to the problems and application of industrial research.

Dr Lowke was Reader in Electrical Engineering at the University of Sydney and has worked on electrical discharges in gases with emphasis on applications in high power lasers, circuit breakers and arc lamps. He is 45, has published 36 papers and has extensive industrial experience.

Despatched

•SIGNETICS has published two new handbooks on their devices which should be valuable to readers designing their own circuits — the Analogue IC Handbook costs $7 and contains information on new op-amps, voltage regulators, D/A converters, etc.; the Analogue Applications Manual (cost: $3) tells you how to use them.

"The bright clear trace makes the Trio CS1560AII easy for operators to use..." says John Shillabeer, Head of Test Equipment Engineering at S.T.C.

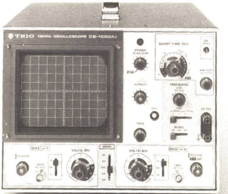
TRIO

John Shillabeer's department is involved in the maintenance, calibration and servicing of all test equipment used within S.T.C. We asked him why S.T.C. used Trio CS1560A scopes.

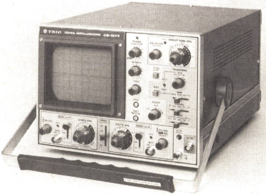
"My department gets involved with all test gear purchases. As a general purpose scope we've found that the Trio provides excellent performance for its price. Being easy to trigger we find staff can readily get it up and going. On the production line, the bright clear trace makes it an easy scope for operators to use.

"Over the past three or four years, S.T.C. has bought 8 Trio 1560s and we've had virtually no trouble from them. Any minor services have been easy to carry out. As you can see we even use one in our department in the development of our own digital test equipment."

15MHz Trio CS1560AII Dual Trace



30MHz Trio CS1577 Dual Trace



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OPAL

The OPAL is available in two forms:

(a) OPAL 1000 $4,800.00

The OPAL is an 8 slot S-100 system conforming to the new IEEE standards. A Delta Products Z80a 4MHz CPU card with 2 RS232c serial and 3x8 bit parallel ports is used in conjunction with the Delta Products Disk Controller. Memory is 64k dynamic RAM. Disk drives are 2x8" Shugart SA801R running at double density (480k/drive) fitted with our exclusive Disk Saver which prolongs the life of the drives and floppy disks and thus reduces routine maintenance. The Disk Saver also reduces the risk of data loss due to power failures. The software is CP/M version 2.3 with Delta Product's utilities. A PROM monitor is supplied. The system is mounted in an attractive pressed Aluminium housing with a cast front panel fitted with reset button and key operated on/off switch.

OPAL 1000 with 64k Static RAM $5,400.00

(b) OPAL System 1000

Terminal: Lear siegler ADM-42 or Beehive DM-20.
Printer: NDK S-2000.
CPU: OPAL 100.
Delivery: 2-3 weeks.
Price: $9,650.00.

Tape Backup $1,010.00

The Corvus Mirror (described under "BACKUP") allows the use of a video cassette recorder as a 100 Megabyte tape backup with random access. Transfer rate is 1.1 Megabaud (10 megabytes in about 10 minutes). The MIRROR can be used for archival purposes. Price includes installation.

Hard disk $5,830.00

The Corvus 10 Megabyte Hard Disk has a transfer rate of 62k bytes/second. Price includes the disk, S-100 interface and installation.

Additional Hard Disk $4,104.00

Shugart SA1000 Hard Disk and Double sided drives to be released soon.

The General Accounting Package
$1,000.00

The system, written for John F. Rose Computer Services Pty Ltd, is a fully integrated Creditors, Debtors and general ledger packages with facilities for online enquiries of all modules at any time. Data entry is in batch mode with a batch proof. An incorrect batch may be deleted before update. The system has been written in Microsoft Basic and compiled under Microsoft's new Basic Compiler to produce an extremely fast package.

General Ledger Features

A user defined chart of accounts allows flexible reporting for small business. All standard accounting reports may be prepared (trading account, profit and loss account, balance sheet etc) by defining the required account and nominating which detail accounts add to that account. Special reports may be prepared in a similar manner. Up to 400 accounts may be used in the standard system. A chart of accounts, financial report and audit trail may be produced at any time. There is provision for an annual budget, month and year-to-date balances and a comparison with last year's results.

Debtors Ledger Features

The Debtors module is a conventional brought forward system which allows up to 400 debtors in the standard system. Reports include: Debtor statements for a single or range of debtors, an aged trail balance, a listing of debtors on file and provision for the analysis of sales this month, year-to-date and last year for each debtor.

Creditor Ledger Features

The Creditors module is a conventional brought forward system which allows up to 400 creditors in the standard system. Reports include: Creditor Remittance Advices for a single or range of creditors, an aged trial balance, a listing of creditors on file and the provision for analysis of purchases this month, year-to-date and last year.

File Space Requirements

A system using 400 debtors, 400 creditors and 400 general ledger accounts requires approximately 198k of disk storage for master file data.

500 debtor and 500 creditor entries per month with a single general ledger dissection will require approximately 102k of disk storage. Multiple General Ledger distributions will require additional disk storage.

Each record requires:

Debtor Master	202 bytes
Creditor Master	202 bytes
General Ledger Master	76 bytes
Debtor Transaction	40 bytes
Creditor Transaction	40 bytes
General Ledger Transaction	62 bytes

Each debtor and Creditor Entry generates 2 General ledger Transactions.

The system has been designed to be easily upgraded for Hard Disk.

Microsoft

BASIC-80 $305.00

Disk extended BASIC. ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records, Random access etc.

Basic Compiler $355.00

Language compatible with BASIC-80 and 3-10 times faster execution. Produces standard microsoft relocatable binary output. Includes MACRO-80. Also linkable to FORTRAN-80 or COBOL-80 code modules.

Fortran-80 $405.00

ANSI '66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80.

COBOL-80 $630.00

Level 1 ANSI '74 standard COBOL plus most of level 2. Full sequential relative and indexed file support with variable file names. STRING, UNSTRING, COMPUTE, VARYING/UNTIL, EXTEND, CALL, COPY, SEARCH, 3-dimensional arrays, compound and abbreviated conditions, nested IF. Powerful interactive screen-handling extensions. Includes compatible assembler, linking loader and relocatable library manager as described under MACRO-80.

MACRO-80 $155.00

8080/Z80 Macro assembler. Intel and Zilos mnemonics supported. Relocatable linkable output. Loader, library manager and cross reference list utilities included.

XMACR086 $300.00

8086 cross assembler. All macro and utility features of Macro-80 packages, Mnemonics slightly altered from Intel's ASM86. Compatibility data sheets are available.

EDIT-80 $105.00

Very fast random access text editor for text with or without line numbers. Global and intraline commands supported. File compare utility included.

Micropro International

Super-Sort 1 $230.00

Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in Binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. Even variable number of fields per record.

WORDSTAR $450.00

Menu driven visual wordprocessing system for use with standard terminals. Text formatting performed on-screen. Facilities for text paginate, page number, justify, centre and underscore. User can print one document whilst editing a second. Edit facilities include global search and replace, read/write to other text files, block move and copy, etc. Requires CRT terminal with addressable cursor positioning.

WORDSTAR — CUSTOM $775.00

Wordstar customized to take advantage of your Terminal's function keys. Functions are directly accessable from the keyboard — all cursor control functions and important file handling functions. Clear plastic instruction sheet for mounting above the keys on the terminal can be provided.

WORDSTAR Interfacing manual $175.00

WORDSTAR/MAIL MERGE
(available May '80) $580.00

Wordstar with the option for production mailing of personalized documents with a mail list produced by DATASTAR or NADS.

DATASTAR $355.00

$355.00 Professional forms control entry and display system for key — to — disk data capture. Menu driven with built learning aids. Input field validation by mask, length, attribute (ie: uppercase, lowercase, numeric, autodup etc.) Built in arithmetic capabilities, using keyed data, constants and derived values. Visual feedback for ease of forms design. Files compatible with all CP/M, MPM supported languages. Requires 32k RAM.

Specials

IP-225 Printer with tractor feed option and full documentation	$900.00
Demonstration NDK S-2000 serial printer with stand and 6 months parts and labour warranty	$3,000.00
Hitachi 17" High Resolution Monitor	$350.00
National TV monochrome Video Camera (Model WV341) with built in monitor and zoom lens	$700.00
64k EXTENSYS Dynamic RAM Board with DMA mod. Used in our own system. Works ok & HAS documentation	$950.00
Newly released 20 key Hex keypad. Includes 4 user defineable keys	$20.00
16K Static RAM Boards, Bank select etc	$400.00
Altos 64k system with 2 x Shugart SA801R disk drives 240k capacity per disk. CP/M version 2.1 and utilities. 90 day warranty. System is our office demonstration unit	$5,000.00
Micromation Z1plus system 2 x Shugart SA801R disk drives at double density (480k/drive), Z80 CPU, 2 x serial RS232c ports, 64k RAM, CP/M operating system. System is our demonstration unit	$5,800.00
Clear Plastic Hemisphere 17½" dia. Ideal for display work at exhibitions and in shops. Stops shoplifting of small items!	$12.00 (good stock)
NorthStar CPU Board Z80a S-100	$250.00 (4 off)
Durst Processor	$658.00 (1 off)
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TSA Operating system, CP/M compatible, our price includes the TSA configuration package that enables you to completely customize the system	$350.00
NorthStar Basic on CP/M. 8" disk is supplied with all patches required to get Northstar Basic running on 8" CP/M disks. Written by TSA	$45.00
Diablo Print Wheels (limited No.)	$12.00
Mostek Z80 programming manual	$8.00 (good stock)
OHIO Scientific C3A Rack Mounted Computer 56k Static RAM, 2 x 8" SA801R disk drives, Z80-6502 and 6800 processors, console and serial ports. Hazeltine 1500 terminal. Software includes CP/M with Basic, Fortran and Cobol. OS-65U and OS-65D disk operating systems	$6,500.00 (or offer)
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Osbourne and Associates

General Ledger	$10.00
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Imsai 8080 23 slot motherboard with 28 amp power supply and front panel control (front panel ahs fault)	$1,000.00
TDL Z80 CPU S-100 board	$380.00
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Morrows 16K Static RAM board S-100	$350.00
Floppy Disk Unit 2 x 8" SA801R with power supply, cabling and cabinet	$1,700.00
2 x California Computer products 16k Ram boards kit assembled and no warranty	$700.00
California Computer Products 16k RAM board with no 2114's	$150.00
Godbout S-100 Bus terminator	$25.00
DEC VT52 terminal with alphanumeric keypad	$900.00

All prices include Sales Tax, but exclude freight. Prices are valid whilst stocks last or until next version of the catalogue is published.

Freight: $5.00 boards, $1.50 components and software, Others: P.O.A.

Send $1.00 for our extensive catalogue covering hardware, systems, peripherals and software. You will be put on our mailing list.

Precision Instruments Made to Measure

• High performance

• Operational simplicity

.. that's the low cost

BWD 804

• Display size	8 x 10cm.
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Space Telescope will extend our horizons

Due for launch in 1983, the Space Telescope will enable astronomers to see up to seven times further than the best ground-based instruments, as well as providing a better 'view', totally unaffected by our atmosphere.

Brian Dance

SINCE MAN INVENTED the first optical telescope in the 17th Century, all of his efforts to extract information from the light reaching the earth have been limited by the effects of atmospheric absorption in the ultraviolet and infra-red regions, convection currents rising from the earth impair the sharpness of images in optical telescopes and cloud cover limits the amount of time for which earth-based telescopes can be used.

Optical astronomers have minimised these problems by siting their telescopes on high mountains, such as Mount Palomar, and by observing objects well above the horizon. A few telescopes have been flown in rockets. However, the limitations of the earth's atmosphere will not really be avoided until NASA's space telescope is launched by the Shuttle about 1983.

The Telescope

The Space Telescope is a multi-purpose optical telescope which will enable scientists to look about seven times further into space than has previously been possible at optical wavelengths. It will unquestionably be the main piece of equipment used for optical astronomical research for a number of years following its launch.

The Space Telescope will orbit the earth at a nominal altitude of about 500 km (310 miles) at an inclination of 28.8 degrees. As it will be above the hazy and turbulent atmosphere of the earth, it will produce images of a clarity greater than those ever obtained with earth-based instruments. At the same time it will cover a wider range of wavelengths (between about 100 nm in the ultra-violet right through the visible to about 1 mm in the infra-red).

The Shuttle will not only be used to launch the Space Telescope, but will also be used to service it in orbit and possibly to replace instrument packages on board the Telescope, since each package forms a module which can be replaced in orbit for new experiments without affecting the overall system. If necessary, the Shuttle will be able to bring the complete telescope back to earth for extensive maintenance or overhaul. The estimated life time of the Space Telescope is not less than 15 years, although it may well be used for a considerably longer period.

The current enthusiasm for the Space Telescope project has grown from relatively small beginnings in the early 1960s. By 1969 the Space Telescope programme had begun to materialise, but it was not until 1976 that a detailed set of Space Telescope designs was prepared by various manufacturers in consultation with the astronomers. In 1978 the programme was approved by the US Congress.

Although the Space Telescope is a NASA project, it has been agreed that the European Space Agency (ESA) will be guaranteed 15% of the observing time in return for the provision by the ESA of one of the instruments for the telescope. The Universities Research Association (which operates the famous Fermi National Accelerator Laboratory, Illinois) has put forward a proposal in collaboration with astronomers to locate a Space Telescope Science Institute at the Fermilab. It is proposed that the Institute will manage the science operations of the orbiting telescope. The Space Telescope programme is under the direction of NASA's Office of Space Science, Washington, but the George C. Marshall Space Flight Centre, Hunstville, Alabama is the lead centre for the telescope, while the Goddard Space Flight Centre, Greenbelt, Maryland is responsible for the scientific instruments and the planning of the telescope operations. The ESA work is managed by the European Space Technology Centre at Noordwijk, The Netherlands. Projects of this size involve so much effort that the collaboration of many nations is highly desirable so that the work is suitably divided.

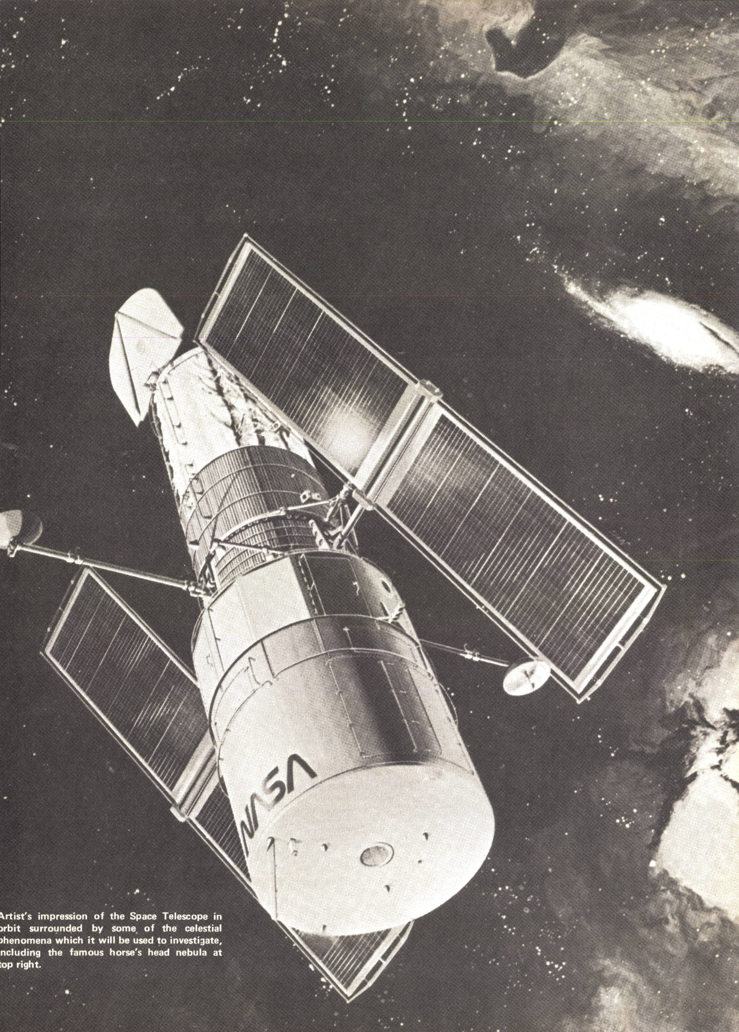
Dimensions

The Space Telescope will weigh some 9 100 kg (about 20 000 pounds or 9.1 tonne) and will be 13.1 m long (43 feet) by 4.26 metre (14 feet) diameter. The basic configuration of the telescope is somewhat similar to that of conventional optical telescopes; it will have a Ritchey-Chretien folded optical system with the secondary mirror inside the focus of the primary mirror. In order to operate at very low light levels, it is vital that stray light should be excluded from the optical system, so the telescope tube is closed and well-baffled with the aperture door serving as a sun-shield. The shielding around the tube also serves as a micrometeorite shield.

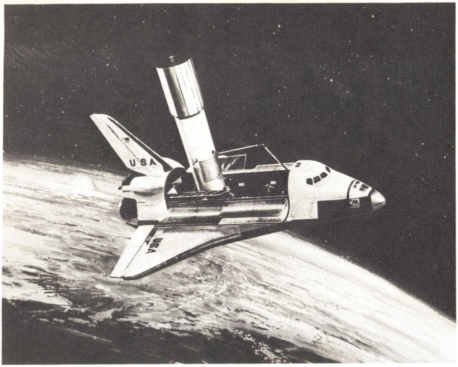
British Aerospace are developing solar panels for the Space Telescope at Bristol which will be able to provide a power level of 4 kW which is required for the transmitting equipment and to enable command signals from the earth to be carried out. This solar cell array will be the largest ever developed in Europe with an area of some 33 m^2.

The diameter of the main mirror of the Space Telescope will be 2.4 m. How does this compare with that of the largest ground-based telescopes? The largest US Telescope is the 5 m (200 inch) mirror diameter of the Mount Palomar instrument, so the Space Telescope mirror will collect less than one quarter of the light collected by the Mount Palomar mirror under the same conditions. Russia has a 6 m (240 inch) instrument, whilst preliminary studies for a 10 m (400 inch) telescope have been made by a team from Berkeley, Los Angeles, San Diego and Santa Cruz (University of California Campuses).

As the Space Telescope has a smaller mirror than these earth-based telescopes, how is it that the Space Telescope can have a higher sensitivity? One reason is



Artist's impression of the Space Telescope in orbit surrounded by some of the celestial phenomena which it will be used to investigate, ncluding the famous horse's head nebula at top right.



Artist's view of the Space Shuttle deploying the Space Telescope in orbit.

the greater sharpness of the images formed in the Space Telescope due to the absence of air which means that the collected light is concentrated into a smaller area. In addition, the background of the sky is much darker due to the absence of light scattered by air and dust particles of the atmosphere and by airglow emission.

It is confidently expected that the Space Telescope will be able to image objects five orders of magnitude fainter than is possible with the best ground-based optical telescopes. The system will employ a remotely operated television-type recording system of much higher sensitivity than a photographic film. In addition, very long periods of observation will be possible with long integration times of the order of 10 hours or more for the detection of very faint objects.

If objects can be seen which are 50 times fainter than those observable with the best earth-based telescopes, it means we can look farther into space by a factor equal to about the square root of 50 or roughly seven times – perhaps even to the edge of the universe? The volume of space which we can observe will be about 350 times (about 7 x 50) that observable from the best earth-based instruments. The observation of extremely distant and faint objects is of crucial importance to the testing of our theories of cosmology.

The mirror of the Space Telescope is a Perkin-Elmer lightweight design of an 'eggcrate' structure fused between the front mirror and the back plate. It is made of an ultra-low expansion glass and its reflecting face will be precision polished by a special computer-controlled polisher developed by Perkin-Elmer.

The mirror will be about 300 mm (12 inches) thick with a centre hole about 600 mm (two feet) in diameter. The unpolished mirror weighs about 907 kg (2000 lb or 0.9 tonne), but after polishing the weight drops to about 748 kg (1650 lb). The optical telescope assembly containing the primary mirror will be completed by December 1982 if work proceeds according to schedule. The final operation on the mirror itself will involve placing it in a vacuum chamber and evaporating the metal reflecting surface on its front face.

Guidance systems

The system which points the telescope at the object to be investigated is of great importance in any telescope; not only must the direction in which the telescope is pointed be controlled with extreme accuracy, but it must be possible to hold this direction very accurately indeed for many hours in order to take advantage of the high optical resolution of which the telescope is capable.

The Space Telescope can be pointed in any direction and provides virtually 24 hours of observation per day. The guidance system will have an accuracy of 0.01 second of arc and will hold the target to within 0.007 seconds of arc for extended periods; this corresponds to 1.944 millionths of a degree or to an error of 10 mm at a distance of 300 km. Precision gyros and guidance by bright stars are used.

The resolving power of the Space Telescope will be 0.1 second of arc. This corresponds to a resolving power of 1 mm at a distance of 2 km. It is expected that its unique capability for high angular

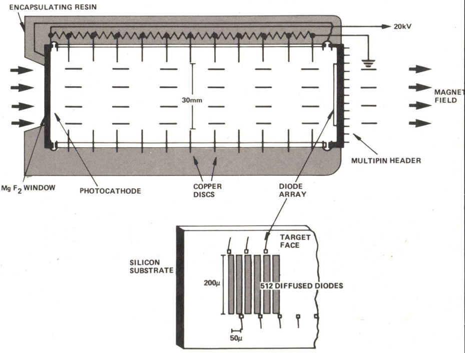
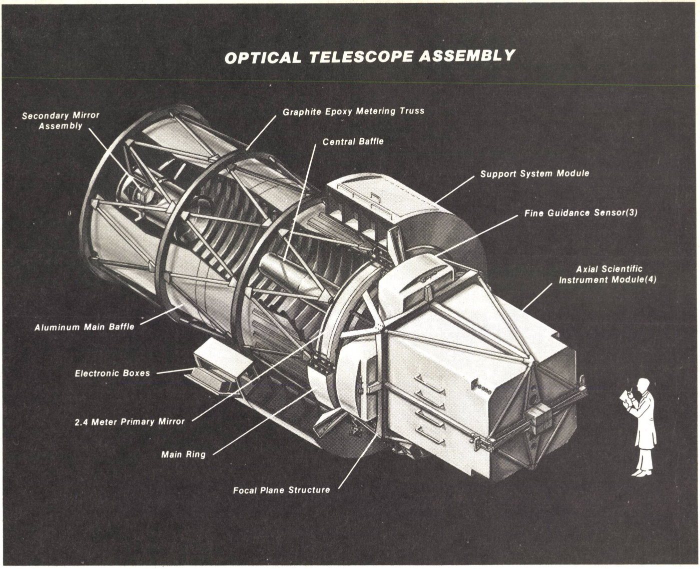


Figure 1. Interior of a Digicon tube (top) with a magnified view of the silicon diode array below it. The spectrum is focussed on the magnesium fluoride window at the left, photons are accelerated across the tube and strike the diode array at the end of the tube, right.



Cut-away view of the optical telescope assembly showing the light baffling arrangement. Light enters from the left, strikes the primary mirror and then the secondary mirror, from where it is passed to the instruments. (Picture courtesy Perkin-Elmer).

resolution imaging together with its other advantages will make it the most powerful telescope ever built. It is interesting to note that enough power will be available to heat the main mirror to about normal room temperature so as to minimise variations from the desired parabolic form.

The resolution of about 0.1 second of arc which will be obtainable with the Space Telescope may be compared with an optimum value of about 1 second of arc obtained with the best ground-based telescopes. (The resolution is often much worse than this with ground-based instruments.)

Cameras

Two imaging 'cameras' planned for the Space Telescope are to cover a wide range of wavelengths. J.A. Westphal of Caltech is preparing the wide-field camera, while a team at the European Space Agency is preparing the second camera which has a smaller field of view, but a higher resolution. This ESA camera will be used for observing very faint objects; it will be able to detect and measure stars as faint as the 28th or 29th magnitude.

The wide-field camera employs a charged-coupled solid state silicon sensor with electric readout. The field of view will be about three minutes of arc by three minutes of arc. (For comparison, the diameter of the moon at the earth is about 30 minutes of arc.)

The faint object camera will employ a photon counting system which has a considerably lower intrinsic background noise. Its field of view will be only about 22 seconds of arc by 22 seconds of arc which is about eight times less in linear dimensions and 64 times less in area than the images provided by the wide-field camera.

The two cameras have been designed for different types of work and will complement one another well.

Spectrographs

Two spectrographs are also included in the instruments to be placed in the Space Telescope; they measure the intensity of the radiation in each wavelength interval. The resolving power is equal to the wavelength concerned divided by the wavelength interval over which the measurement is carried out.

A high resolution spectrograph for the Space Telescope is being developed at the Goddard Space Flight Centre mainly for use at a resolving power of 20 000, but resolving power of over 100 000 will be possible, although higher values of resolving power imply longer measurements for a given intensity and accuracy.

A spectrograph for faint objects is under development at the San Diego ▶

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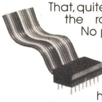

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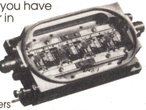

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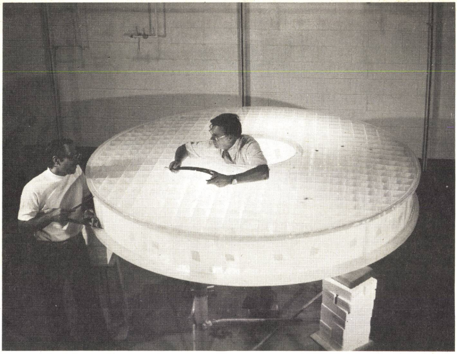

Inspecting the Space Telescope's mirror. This lightweight core of small glass plates cemented vertically will be sandwiched between two glass plates and the reflective coating applied to one. (Picture courtesy Perkin-Elmer Inc., USA).

Laboratory of the University of California, but the resolving power is not so high as that of the high resolution instrument. For very weak sources, the resolving power can be less than 100.

Both of these spectrographs use a Digicon tube (see Figure 1) as the detector. This type of tube was chosen because it is relatively simple and because its performance has already been proved in ground-based telescopes. A diffraction grating is employed to focus the wavelengths of interest onto the Digicon faceplate; the wavelength will be changed on command from an earth station. A single exposure is enough for the Digicon to provide the number of photons counted in each of the 512 channels.

In Figure 1, the spectrum is focused on the magnesium fluoride window on the left hand side. The electrons generated when the photons strike the window are accelerated by a 20 kV electric field across the tube. They strike a diode array at the far end of the tube. Each diode constitutes a separate channel and the output from each channel is fed to its own separate preamplifier circuit which in turn passes an output to a photon counting circuit. The diodes of the array are of silicon and have a width of only 50 μm and a length of 200 μm.

Data acquired by the Space Telescope will be transmitted back to earth as the satellite orbits over an appropriate receiving ground station. NASA's Spaceflight, Tracking and Data Network (STDN) will be used to complete the communications network between the Space Telescope and the ground operating systems. Where necessary, the Tracking and Data Relay Satellite System (TDRSS) will be available to carry data to the ground.

The data will be sent to computers which will convert it into the best possible images or into the best form for use.

Applications

The possible applications of the Space Telescope are obviously too numerous to mention, but we will consider a few of the possibilities.

The Space Telescope, with its high angular resolution, will be able to search for planets which may possibly orbit other stars in the same way that the earth and planets of the solar system orbit the sun. There are 37 stars within 15 light years (90 million million miles) of the sun and 10 stars of a similar type to the sun within 30 light years distance from us; we shall be able to find out if any of these stars have planetary systems comparable in size to that of the sun.

The high angular resolving power of the Space Telescope will also enable us to investigate the very important binary and multiple star systems. Such binary systems are of especial interest where one of the components may be a neutron star or even a black hole. It is intended that the spectrographs will be employed to investigate such systems and the gas between the components of the systems to find out as much as possible about the physical processes which are occurring there. The gas pulled out of a binary by a possible black hole would be especially interesting to study.

It is also intended to use the Space Telescope to try to establish the distances of galaxies more accurately, since their relative distances are known much more accurately than their actual distances. Cepheid variable stars are used in these measurements, since their intrinsic brightness can be estimated from the period with which the brightness varies; if their actual brightness as viewed from the earth is estimated, one can calculate their distance knowing their intrinsic brightness. Cepheid variables have not been detected outside our own local group of galaxies using earth-based telescopes, but it is expected that the Space Telescope will be able to detect Cepheid variables at distances up to ten times those so far detected.

A more accurate estimate of the distances of these galaxies should thus be obtained and this will enable us to make a more accurate estimate of the distances of more distant galaxies; it may enable us to estimate the time of the 'big bang' at which the universe was born.

Although our inter-planetary probes have sent us back excellent images of the planets of our solar system, these images have been obtained only over relatively short periods of time. The Space Telescope will provide extremely detailed images of the planets and their weather systems over much longer periods and this information will be supported by the sending of Orbiter vehicles to the planets, such as the Orbiter already passing around Venus and the Project Galileo Orbiter planned for Jupiter. The study of planetary weather patterns should enable us to improve our terrestrial weather forecasts.

Probably some of the most interesting uses of the Space Telescope will be the chance discovery of information vital to our understanding of some part of the universe, but it is not possible to speculate on the paths to which such discoveries may lead us!

Conclusions

The Space Telescope will be a vital tool in man's exploration of the universe in the mid-1980's. However, it is not likely to replace earth-based telescopes, since the latter offer the most cost-effective way of obtaining systematic data about the heavens. The Space Telescope will initially, at least, be used only for projects which cannot be satisfactorily carried out with ground-based observatories. The estimated cost a few years ago was US$400 million, but this has doubtless been lifted by inflation. ●

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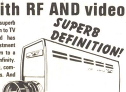
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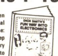
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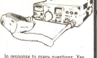

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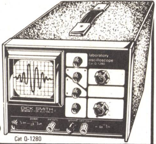

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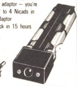

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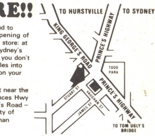

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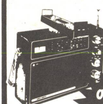

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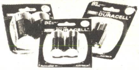

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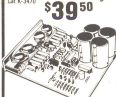

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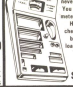

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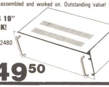

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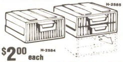

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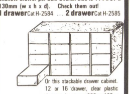

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Dick Smith and Staff

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Receivers for the budget-minded shortwave enthusiast

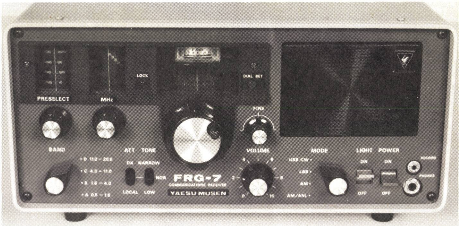
Bob Padula

Interested in shortwave DXing but short of cash? Here's how to look for a set to suit both your needs and your budget.

EARLIER ARTICLES in our DXer series discussed the basics of shortwave listening. DXing techniques, reception reporting, and QSLs. This time, we'll look at types and capabilities of some currently available receivers, and in particular, the sort of gear that is now becoming increasingly popular through secondhand sources.

Over the past couple of years, high quality receiving equipment from Asian factories has virtually saturated the world market. As a logical and predictable outcome of the substantial capital investment for the design, development, and high-volume manufacture of CB equipment, many factories have now entered the general field of long-run production of high quality receiving gear at prices which Asian consumers can afford.

The hobby of DXing, or, as it is known in Japan as "BCL" ("Broadcast Listening") has rapidly developed on a vast scale, being particularly attractive to teenagers as an alternative to the earlier, but somewhat short-lived popularity of CB radio. Discussion of the many reasons for this tremendous upsurge in DX radio listening is beyond the scope of our present article, but it should be noted that Radio Australia's weekend, prime-time evening audience in Japan has been conservatively estimated at several million. As well, there has been a remarkably high level of interaction and collaboration between Japanese equipment manufacturers, and distributors, and the support offered by commercial publishing houses dealing exclusively in DX/BCl literature — a practice which is virtually non-existent elsewhere. The "umbrella" organisation, "The Japanese BCL Federation", commercial in nature, exercises extraordinary control and management over the multitudes of regional BCL/DX groups throughout the country, with intense penetration and involvement with the national educational systems.



The Yaesu FRG-7 is a solid-state general coverage receiver employing the drift-cancelling "Wadley Loop" front end. It sells for around $350-$400 new, about $100 less second-hand.

The accelerated penetration of Japanese communications receiving gear onto the world market needs no further emphasis. However, for the Australian hobbyist, there is a catch. Import and sales taxes tend to have a serious dampening effect for the local buyer and for the younger DXer, with limited funds, the $350 price tag is often the biggest barrier. It appears that the majority of new set sales in the $350 — $500 bracket are going to older people, generally folk who are interested in shortwave listening as an alternative information and entertainment medium.

The interesting thing about all of this is that there has been a steady trend in the availability of good, general-purpose communications gear entering the secondhand market. It is this avenue of purchase that should be explored by the younger or financially limited older hobbyist. New sets are being released onto the market regularly, and established models are continually being modified and upgraded. There seems to be a trend nowadays for listeners to rush out and buy the newly released, new model of the "ZZZZ999" receiver, possibly out of a need to own "the best and latest" even though the general specifications may be identical to the superceded version, with only "cosmetic" modifications to appearance and finish being introduced. The almost new, superceded set invariably finishes up on the secondhand market, often going for a ridiculously low price, and it is here that the buyer can come out well on top.

Bob Padula is from the Australian Radio DX Club, a non-profit organisation catering for people interested in mediumwave and shortwave 'DXing'. More information about the ARDXC and their activities can be obtained from either P.O. Box 67, Highett, Vic 3190, or from P.O. Box 79, Narrabeen, NSW 2101, for a 30¢ stamp.

Good bargains are also available for the older tube type sets, and for the remainder of this article, we'll discuss what to look for in secondhand sets, with a few tips for bringing their performance to "as new".

Tube receivers

Multi-band receiving equipment during the 1950s was generally limited to military surplus gear, for the Australian hobbyist, or to what he could make himself from published designs, using locally available parts. Imported gear was essentially confined to what could be brought back from trips to the USA or Europe, and was limited to those with plenty of spare cash! Solid state equipment had not been developed in the early 1950s, at least for reliable HF performance, and the era was marked by such military surplus equipment as the R1155, AR8, Marconi CR100 (B28), AR88 (RCA) and the famous HRO (National). Most originated during World War II, were made to last and are still giving good service today in DX and ham shacks around the world.

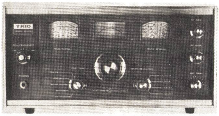
Many designs were of the single-conversion superhet, with possibly two RF and three IF stages, with some form of mechanical bandspread. Variable selectivity using crystal filtering was featured on some designs, and most sets had faciities for balanced antenna inputs. The AR8, originally installed for the RAAF, coupled to the AT5 transmitter, had an IF of around 900 kHz, which whilst giving better image rejection than the standard 455 kHz arrangement, suffered from selectivity shortcomings. The writer uses a Marconi CR100, originally manufactured for the British Navy, and acknowledged by many listeners as being the ultimate set of its time, with variable selectivity, crystal filter, superb sensitivity, and extremely high temperature and mechanical stability. The one in use here has been modernised, using miniature tubes in the RF stages, but some of the original octal based tubes are still in use, now approaching the 40 year mark! This type of gear is becoming rarer on the used market, as it is virtually living on borrowed time, with maintenance being the responsibility of the technically trained owner. American firms, such as Hamerlund, Hallicrafters and National, had for several years been producing multi-band gear but which needed conversion to Australian power-line standards after importation. Some were factory modified for Australian conditions and occasionally appear on the used market. Maintenance and spare parts are a problem.

During the early 1960s, when Japan emerged on the world receiver market, the American and British firms were hit very hard with the type of competition offered, and both Hamerlund and National ceased production of communications receivers altogether. Among the first of the Japanese general purpose tube-type communications receivers released here was the Lafayette HE30 The design of this set was to be the standard for many years — it featured straight-line tuning dials (main and bandspread tuning), single conversion, 455 kHz IF, RF stage, RF and AF gain controls, front panel antenna trimmer, it had adequate selectivity and excellent sensitivity. Image problems ("double spotting" from twice the IF — 910 kHz) were usually reduced by outboard antenna tuning units or preselectors, giving increased RF selectivity in the front end.

The Lafayette HA600, a popular older-style solid-state set featuring slide-rule scale and a 'bandspread' dial.

There were several variations on this basic theme, Star offered its "JR" series while Lafayette released a variety of sets in the "HA" series, some with VHF and/or longwave coverage. The most popular model was the HA230, with straight-line tuning for both main and bandspread, and coverage up to 30 MHz. In the early 1970s, the tube versions were finally displaced by solid-state designs, all in the HA-00 series (such as HA600, HA600A, etc.).

Trio eventually offered its later model tube designs, beginning with the 9R59DE, in 1967. Strangely, an American version of this set was never manufactured. Various designs followed, such as the 9R59DR, -DS, all tubes. Circuits were similar to the Lafayette sets, but with two "window" circular dials instead of the straight-line tuning. The 9R series were eventually replaced by solid-state designs, beginning with the QR-666, in the mid 70's, and in turn this was superceded with the R-300. Neither set proved very popular, due to poor crossmodulation characteristics and overloading effects from strong signals on the lower frequencies.



One of the most popular tube sets was Trio's 9R59DS. It's still a good performer.

The Trio 9R series represented excellent value for the money when new and secondhand sets are showing up continuously today. Expect to pay around $100 — $120 for a good one, or $80 — $100 for one that needs some work on it. Selectivity characteristics are superior for serious DX work, compared with many of the current generation solid-state radios, and their sensitivity is excellent. Two mechanical filters are used in the IF channel, yielding relatively steep-sided IF passband characteristics, necessary for serious DX work in the HF bands. The main drawback with the 9R series is their drift, particularly during warm-up. Installation of a voltage regulator tube (VR150) across the oscillator supply is recommended by the manufacturers, and costs little; a big improvement will be apparent. This set is undoubtedly the most popular tube type set ever released, and thousands are in regular use in DX shacks in Europe, New Zealand, Japan and Australia.

This set gives impressive performance over the entire MW-SW spectrum, and using tubes, does not exhibit cross-modulation or overload problems for SW work on the lower frequencies or on mediumwave. A hint: some models tend to mysteriously fail to operate on the LF end of the 4.8 MHz — 14.5 MHz band; this is due to decreased emission with age, of the 6AQ8 oscillator tube, particularly where mains voltage fluctuations occur. If using such a model, replace this tube.

Making tube sets "as new"

Tube sets seem to go on for ever. However, deterioration in performance is so gradual that the user often fails to recognise that something needs to be done. If buying a secondhand tube set, try and have new tubes fitted, at least in the RF, mixer, and IF stages. Some maintenance pointers:

- Vacuum out particles of dust and lint — use a small brush to get into the crevices, on top of the chassis.
- Remove the tubes and carefully clean the pins and sockets with a spray, such as CRC.
- Alignment may need "tweaking" — follow the instruction manual, or alternatively, peak the RF and mixer circuits at the HF end of each band, and coil slugs at the ▶

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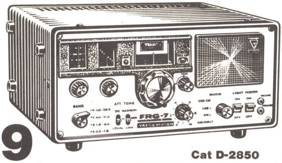

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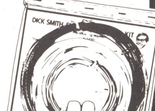

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LF ends. Check dial calibration, and if badly out, realign using oscillator coil slugs at LF ends, or oscillator trimmers at HF ends. Some sets may have variations to this – consult the operator's manual. Alignment can be done by ear, if you know what you are doing, for maximum output, but should ideally be carried out with proper laboratory equipment to establish the correct selectivity passband shape in the IF channel.

- Volume, tone control potentiometers can be sprayed, as for the tube sockets, to reduce or eliminate noisy operations.

When buying a used set, make sure that you get an operator's manual, or at the very least, a copy of the circuit. If the set appears to have been modified, ensure that the circuit changes are marked up either in the manual or separately.

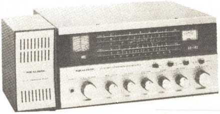
The comments above are intended to apply to such sets as the Trio 9R series, or the Lafayette HE series. Older type tube sets will generally require considerably more electronic knowledge and expertise, particularly if conversion to modern tubes is undertaken. The author would be happy to advise on a series of modifications that can be made to the Trio 9R59, but which would require a high level of technical ability and "hands-on" electronic experience.

Solid-state receivers

The first non-professional general coverage solid-state communications set was possibly the Eddystone EC10. Produced in England, the set was sold around the world in the early 1960s. Its performance on SW was rather good, with adequate selectivity and sensitivity, but it lacked punch on mediumwave. Fully self-contained, it operated off internal "D" cells. A modified version was later released, the Mark-2, featuring a fine tuning control.

Production of the EC10 ceased around the early 1970s. Both versions appear in the used market, and are good value at around $100 – $120. A comprehensive operating handbook was supplied with each receiver at time of original purchase, and should accompany the set, as it contains full alignment instructions and circuits.

The Lafayette HA600A/600/800 series are frequently seen in the second-hand market. The first models exhibited very poor crossmodulation and overload characteristics and were unpopular for serious mediumwave work in high signal strength areas. Their performance on the low frequency SW bands was somewhat restricted, at least for users in the main capital city areas. Away from strong mediumwave locals, these sets are quite good, and can be operated off external 12 V supplies for portable work. Average prices for good used models in the HA600 series are about $140 – $150. Do not buy a set in this series if you want to get involved in serious MW work from a capital city area. The HA800 was the amateur bands version.



Tandy's DX160, under the Realistic label, can be obtained for as little as $150 – good value.

A set that has gone somewhat unnoticed in recent years is Radio Shack's DX160. Solid-state, it has been selling through Tandy outlets for $240, and covers from 150 kHz to 30 MHz. It has separate dials for main and bandspread tuning and showed good selectivity and sensitivity, and proved similar in performance to the Lafayette HA600 series. However, double-spotting was a problem with this set, as with most of the single-conversion receivers, including the Trio 9R, and Lafayette HE and HA series. Some form of outboard antenna tuning unit or preselector would be a useful addition. The DX160 can work off an external 12 V DC source, making it suitable for DX-peditions. Used DX160's fetch around $150, and whilst not as sensitive or selective as the Trio 9R, this sort of cash outlay represents good value for the money. A report from USA indicates that the DX160 has now ceased production, possibly in favour of the digital readout DX300. One feature with the DX160 not commonly found on similarly priced sets is the fast/slow AVC control.

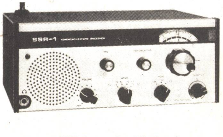
Sony put out its solid-state CRF160 in the early 1970s. It covers LW, MW, FM, and ten SW ranges (each 600 kHz wide, representing the main international SW bands). Sensitivity is good, but selectivity is a little inferior for serious DX work. It operates either off 240 V mains or via six "D" cells. Still available new through some sources; used models go for around $250 – $300. Marketed as a portable, it is somewhat large and bulky; has inbuilt speaker and is a double superhet design.

Sony's CRF-150 covers LW, MW, SW and FM

New generation gear

The sets already mentioned conform, essentially, to traditional design concepts generally single conversion, but with some double conversion models represented. In the late 1960s, the South African produced Barlow-Wadley XCR130 appeared. This used the phase-locked drift cancelling loop design, giving virtually rock-steady frequency stability, good selectivity, adequate sensitivity and image problems. It was widely marketed in Europe, Africa and Australia and was the first of the new generation sets to offer frequency readout accuracy much better than the conventional superhet designs. The new price was considered by some DXers to be high (around $400) and design weaknesses subsequently became apparent due to the internally generated "birdies" every 1 MHz, plus others. The set was promoted as a portable, and gave good service as such. It was also used (and still is) as the main receiver in many DX shacks. It is available on the used market, but maintenance and alignment can be tricky unless the buyer is technically trained. Used models go for $200 upwards (close to original retail price) and this writer does not believe that this is good value compared with other equipment now available

Drift-cancelling "Wadley-loop" designs are now proliferating. Yaesu-Musen brought out its FRG7 in 1976. It is still going strong, currently retailing for $300 – $395. Other companies also offered similar designs, such as Sony's ICF6800 (1978), Drake's SSR1 ▶



The Drake SSR-1, another Wadley Loop set.

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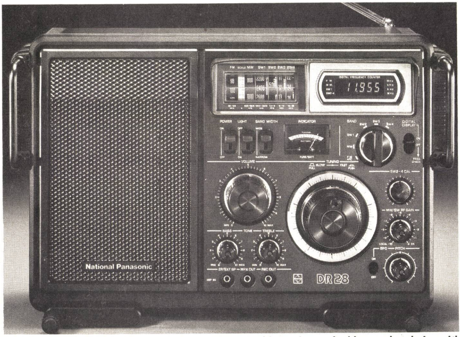
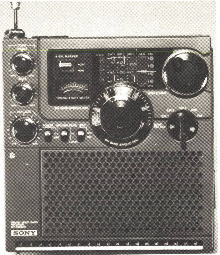
(1975), and the Century and Standard (1978). The design is often identified by the 1 MHz tuning dial, either concentric with, or separate from, the main tuning dial. Frequently, a "preselector" control is featured. The FRG7 has adequate frequency readout, down to about 5 kHz, and covers 500 kHz to 29 MHz, with good sensitivity. Drake's SSR1 has not been so popular, due to problems with spurious signals. In 1978, Yaesu released its FRG7000 an elaborate set with digital frequency readout and quartz crystal clock. Many FRG7s changed hands in favour of the FRG7000, as people wanted digital readout. As a result, there are continuing offers of FRG7s on the used market and a good price is around $250. The FRG7 can also work off a separate 12 V DC source, and works well with relatively small antennas.

National released its digital readout model DR48 in 1978, a double superhet, and this was superceded by the DR49 in 1979. Designs are similar. DR48s are now showing up on the second-hand market and a reasonable price is around $350. DR49s new can be obtained for $470, which is about the minimum after shopping around. The DR48 (and DR49) is an excellent general coverage set, with excellent sensitivity and adequate selectivity.



The DR28 from National Panasonic is a popular portable receiver, a double superhet design with digital frequency readout. They may be picked up second-hand for around $250, or new for around $100 more.

National also offers its intermediate set, the DR28, a double conversion design with digital readout, but there are problems with double spotting from signals 4 MHz removed from the signal frequency. Used DR28s are to be found, with prices around $250, and the set is a current model.



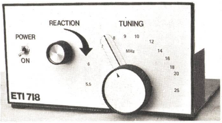
A popular portable is Sony's ICF-5900. A good, low-priced beginner's receiver.

A little set that packs a big punch is Sony's ICF5900W. Released in Australia in 1978 it is small enough to be taken along whilst travelling (even over the shoulder), and works really well as a main receiver, either off internal dry cells or via a mains adaptor. It has a unique tuning mechanism, with readout accurate to about 5 kHz. Currently available, it sells for about $240 new. Selectivity is perhaps a little wide for really serious work, but is good enough for the price! Used models are snapped up quickly, and a good price is around $160. Frequency range is from MW through to 30 MHz and it includes a BFO for SSB/CW reception.

Summary

The increasing availability of general purpose sets on the used market is providing plenty of scope for people new to DXing, and particularly for younger folk with limited funds. Do not buy older war surplus sets unless you are competent to carry out maintenance and fault finding yourself. More modern tube sets, such as the Trio 9R and Lafayette HA series, are good buys but you will need to recognise that spare tubes will be harder to get as the years roll on. If you are not interested in MW work, then you should look at something like the FRG7, or DX160. If digital readout is what you want, then the DR48 or DR28 are the ones to keep in mind. The use of a simple antenna tuning unit for all types of single-wire antennas is recommended where image problems are severe. This can consist of the ordinary "pi" design, with one tapped coil and two variable capacitors. The tuned circuits give the required boost in RF selectivity, thus reducing double spotting effects. The unit also matches the antenna to the receiver, giving an improvement under most reception conditions. The coupler can also be used with a balanced feeder, such as a dipole.

Standard's C6500 is an economical Wadley Loop set — reviewed in ETI, June 1979.



The ultimate in budget SW receivers ! The ETI-718 was described in the October 1979 issue and should cost less than $30.

Used equipment is proliferating these days, and with a sensible study of features, price, and maintenance aspects, the younger, budget conscious DXer should explore the secondhand market widely. There are probably thousands of unwanted sets lying around in cupboards — many of these have never been advertised, and can often be had "for a song" if you are enterprising enough to put your own "wanted" advert. in electronics magazines or "Trading Posts".▶

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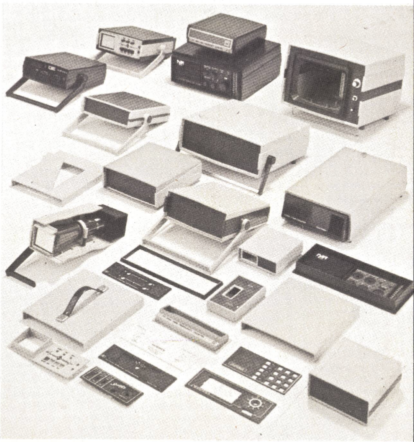

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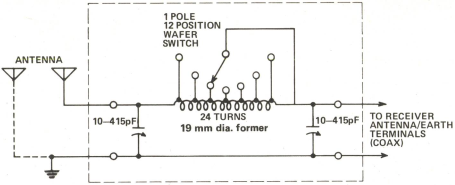

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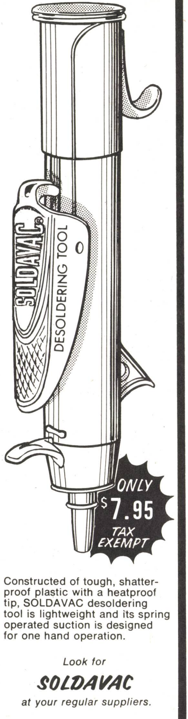

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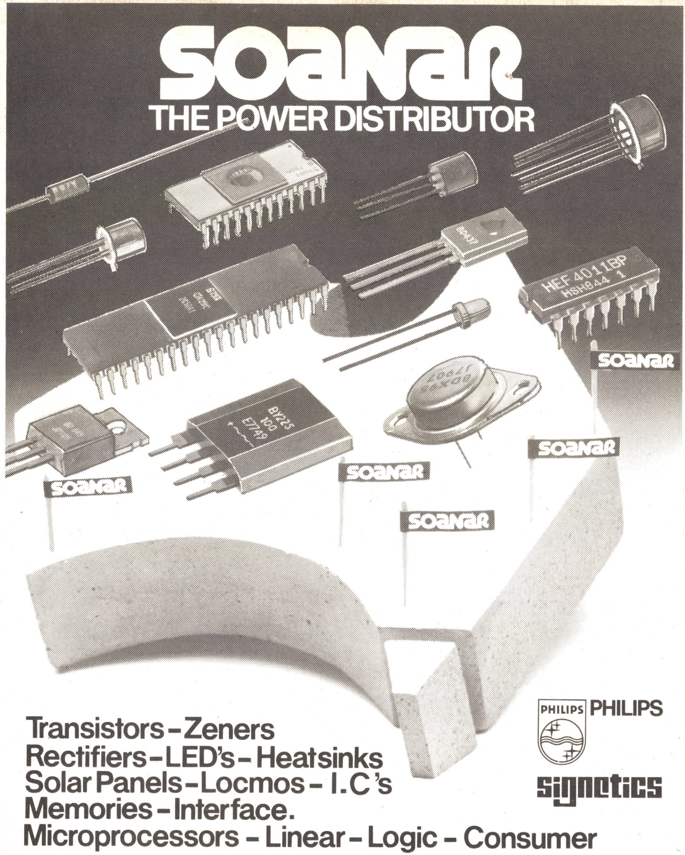

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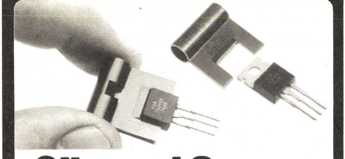

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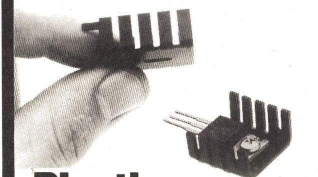

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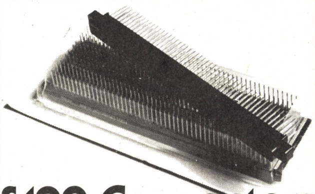

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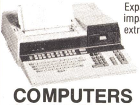

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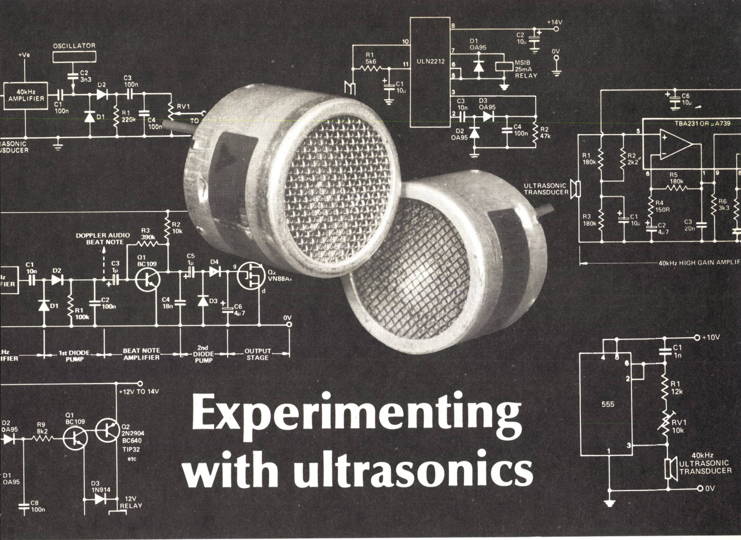


Experimenting with ultrasonics

Brian Dance

Inexpensive ultrasonic transducers can be used in a fascinating variety of gadgets and circuits, from garage door openers to 'bat detectors'. This feature is especially for the experimenter.

MINIATURE ultrasonic transducers can be used to generate high frequency waves in air which cannot be heard yet which have a wide range of applications in remote control, short-distance communications and in the detection of intruders. This article reviews the type of circuits in which these transducers are normally employed and will provide the experimenter with plenty of ideas to try; practical circuits are given, without constructional details.

Two main types of ultrasonic unit will be discussed. **Transmitter units** are oscillators in which high frequency oscillations are fed to a transducer which produces ultrasonic air waves in much the same way as a loudspeaker produces audible air waves. If the waves from a transmitting transducer are allowed to fall onto a transducer in a receiver unit, very small signal voltages are developed by the receiver transducer and these signals may be suitably amplified to operate a relay or an alarm. The relay can be used to switch any other equipment, but some receiver units include complex logic circuits.

The main limitation in the use of ultrasonic air waves is the limited range over which they can operate — usually not much more than 30 metres. Although microwave beams can be used over much greater distances, ultrasonic systems are far simpler and cheaper. In addition, the waves are not radiated far outside the room or region concerned.

Frequencies

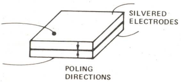
The frequencies used are usually in the range 20 kHz to 60 kHz. The average adult can hear frequencies of up to about 15 kHz, but some young people can hear considerably higher frequencies, so this sets a lower limit of 20 kHz to 25 kHz. The uppermost frequency is set by the rapid increase in air absorption of the waves which occurs at frequencies above about 50 kHz and which limits the maximum range at which detection can occur. (Much higher frequencies — about 1 MHz to 10 MHz — are used in ultrasonic applications in medicine, whilst GHz ultrasonic frequencies can be used in acoustic microscopy, but no air transmission is then involved.)

Ultrasonic transducers can operate efficiently only near the resonant frequency of the ceramic piezo-electric element they contain. Most of the transducers on the market resonate at either 40 kHz or 25 kHz; the performance at these two frequencies is not so very different, but the 40 kHz ▶

types are more directional.

An ordinary sound wave around 300 Hz has a wavelength of the order of one metre, so it is diffracted at the edges of common objects whose size is not much larger than the wavelengths concerned. Thus, ordinary sound bends around the edges of objects. However, the wavelength of 40 kHz waves in air is only about 8 mm; this is much smaller than most common objects found in a room so the waves are effectively stopped by objects of dimensions greater than a few centimetres. In practice this means that the ultrasonic transducers are strongly directional, the output from an ultrasonic transmitting transducer being about 10 dB down at 30° from the direction in which the transducer faces. Similarly, the receiver sensitivity falls by a similar amount when the incoming waves are off the transducer axis.

In the open air, the ultrasonic transducers must be pointed approximately towards one another or little response will be obtained. In a room of a normal size, however, ultrasonic waves are reflected from walls and objects so that a single transmitter in a room will cause the whole room to be filled with ultrasonic waves.



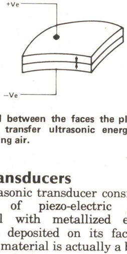


Figure 1. **A piezo-electric ceramic element consists of two plates of opposite poling directions cemented together. When a voltage is applied between the faces the plates bend and can transfer ultrasonic energy to the surrounding air.**

The transducers

An ultrasonic transducer consists of a square of piezo-electric ceramic material with metallized electrode surfaces deposited on its faces. The ceramic material is actually a bimorph element, which means that it consists of two separate layers fastened together, these layers having their electric dipoles aligned in opposite directions as illustrated in Figure 1.

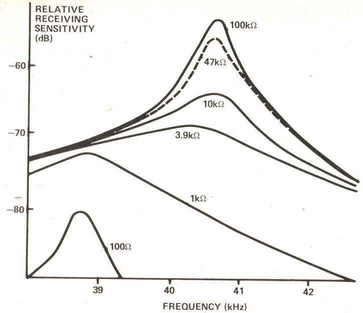


Figure 2. **A set of curves showing how the frequency response of a sharply-peaked 40 kHz receiver transducer is affected by various values of load resistor.**

The ceramic bimorph element is suitably mounted so that its vibrations are not damped by the mounting and is fixed inside a small case, which is usually cylindrical, measuring about 10-25 mm in diameter and about the same length. The front has an open mesh so that the ultrasonic waves can pass easily into or out from the ceramic element. If the transducer case is made of metal, the case should preferably be at ground potential.

The ceramic elements couple to the surrounding air with a reasonable degree of efficiency. The ultrasonic power output from a typical transducer can be of the order of 10% of the electrical power fed to that transducer.

Some suppliers offer types of ultrasonic transducer which are designed to be used as either transmitting or receiving transducers. Other types available have some differences between the transmitting and receiving transducers. Although the functions of these components may be interchanged, there will be some sacrifice in performance or in their safe ratings in many cases.

The writer performed some measurements on the frequency response of one type of transducer specifically designed for use in receiver units and obtained graphs similar to those of Figure 2, published by the manufacturer for various load resistors connected across the transducer terminals. It can be seen that if a load resistor of 10k is connected across the transducer terminals instead of 100k, a loss of about 10 to 12 dB in sensitivity results, but the bandwidth is considerably increased. At lower values of load resistor, the resonant frequency is reduced somewhat, but normally the effective load should not be less than a few kilohms.

When transducers specifically designed for use in transmitter units were used as receiving units, it was found that they behaved in the unloaded state rather like the receiver transducers would behave when loaded with about 4k7 to 10k. Thus, the transmitter devices have much flatter response curves. Transducers supplied for use as either transmitters or receivers were also found to have fairly flat response curves. One may guess then, that a receiver unit with a sharply peaked response may be ideal for the detection of weak ultrasonic signals in the presence of noise, but transmitter units are more broadly tuned so as to ensure that they can cover the receiver frequency peak.

Transmitter circuits

One of the simplest ways of constructing an ultra-sonic transmitter is to connect the transducer across the terminals of a signal generator set to the resonant frequency of the transducer. Either a sine wave or a square wave may be used, but care should be taken to ensure that the maximum permissible rating of the transducer is not exceeded. It is possible to use ultrasonic transducers under pulsed conditions, but care is needed to obtain good results.

It is possible to design oscillators for driving ultrasonic transducers using only a single transistor, but a feedback transformer is necessary and it is usually easier to design a two transistor astable circuit which requires no transformer. An astable circuit of this type, designed by Philips-Mullard for

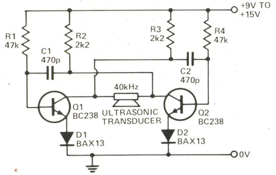


Figure 3. **An ultrasonic transmitter using discrete components. Synchronisation with the 40 kHz transducer is automatic. For 25 kHz operation, C1 and C2 should be increased to about 750 pF (560 pF and 180 pF in parallel). Most silicon NPN transistors can be used for Q1 and Q2; e.g: BC108, BC548 etc.**

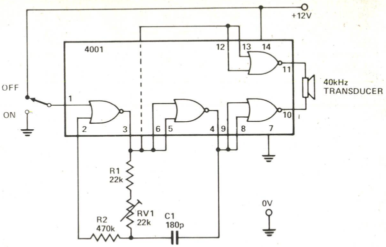


Figure 5. **A CMOS 4001 push-pull transmitter circuit. For 25 kHz operation, C1 should be increased to about 270 pF. A CMOS 4011 NAND gate can be used instead of the 4001 device but the ON and OFF connections to the switch are then reversed.**

their 36 kHz transducers, is shown in Figure 3. The diodes in the emitter circuits of the transistors suppress the reverse voltage peaks occurring between the base and the emitter; these peaks are likely to exceed the maximum permissible reverse value of 5 V for the transistor types shown and at the same time can give rise to frequency fluctuations. The diodes are not needed at low supply voltages, but the ultrasonic output is then lower.

The natural frequency of oscillation of the circuit in Figure 3 is determined by the time constants R1-C1 and R4-C2, but this natural frequency is made lower than the required frequency. When the ceramic piezo-electric element of the transducer is connected across the two collectors, the oscillations of the circuit make the transducer ring. The ringing transducer generates a voltage which causes premature triggering of a cut-off transistor so that the oscillator is synchronised to the transducer frequency. Thus, no trimming of the oscillator frequency is necessary in this particular circuit. Current consumption is about 5 mA with a 9 Vdc supply.

Circuits can usually be simplified by the use of integrated circuits instead of discrete components. Figure 4 shows how a 555 device can be used to drive an ultrasonic transducer at about 40 kHz. The preset resistor, VR1, should be adjusted for maximum current consumption which occurs when the 555 oscillator frequency matches the transducer frequency and maximum power is radiated. The 555 produces square waves with a mark-to-space ratio of about 1:1. If 25 kHz transducers are to be used, C1 should be increased to 1n5, alternatively R1 can be increased to about 18k.

Another simple ultrasonic transducer circuit is shown in Figure 5; it uses the 4001 quad two-input CMOS NOR gate. Two gates act as a square wave oscillator which drives the other two NOR gates in push-pull. The latter act as buffers and drive the transducer in push-pull, preventing any voltages from the transducer from affecting the oscillator itself. The oscillator frequency can be adjusted by means of the preset component VR1 so that maximum current is taken from the supply line. Capacitor C1 should be increased to 270p for 25 kHz operation.

The performance of each of the oscillators shown in Figures 3 to 5 inclusive is very similar.

More complex transmitter units can be made which radiate a modulated waveform or a pulse-coded waveform. For example, a 556 device (dual 555) can be employed to generate a 300 Hz signal to modulate the second 40 kHz oscillator of the 556; the advantage of using modulated ultrasonic waves is that the receiver can be made selective to the 300 Hz modulating frequency and reject noise.

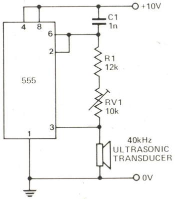
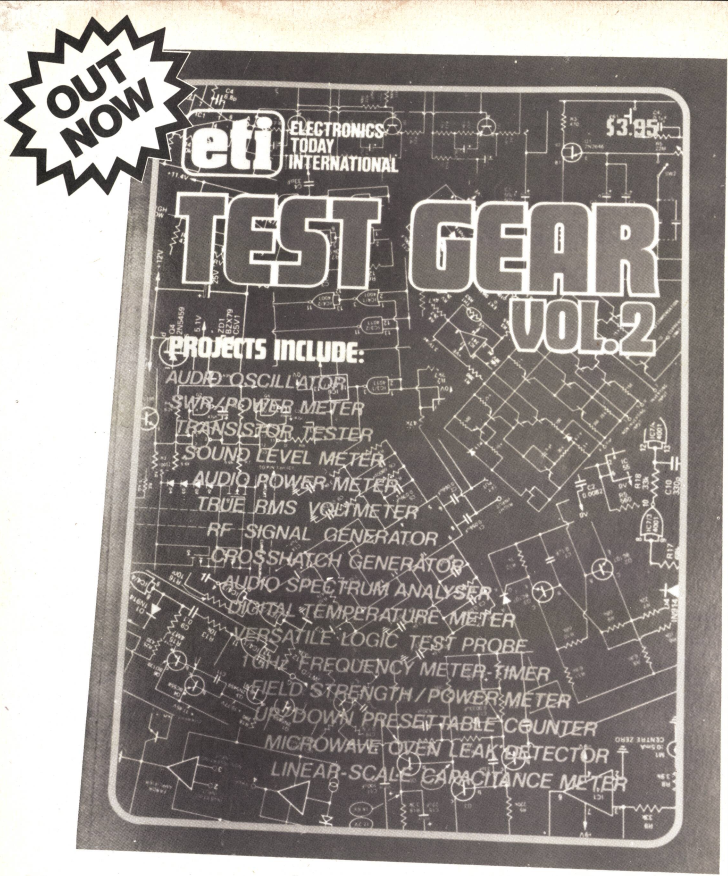


Figure 4. **A transmitter circuit employing a 555 timer/oscillator IC. For 25 kHz operation, C1 should be increased to about 1n5.**

Receiver units

In the same way that the ceramic piezo-electric bimorph element bends when a voltage is applied across it (Figure 1), when ultrasonic waves fall on it, the bending of the element generates a small voltage across the transducer terminals. This voltage is a 40 kHz waveform, but unfortunately the amplitude is quite small. When the transmitting and receiving transducers are placed face-to-face and touching one another the voltage across the receiver transducer terminals is typically less than one volt, but at a distance of about 30 meteres the voltage across the receiving transducer falls to some tens of microvolts and any further increase in the distance between the transmitter and receiver will be likely to result in the signal being lost amongst the noise.

Thus, it is clear that an amplifier of considerable gain must follow the receiving transducer in the receiver unit. This amplifier may consist of discrete transistors, but the circuit can be considerably simplified by the use of one or more integrated circuits. In particular, it is interesting to note that the ICs developed for the amplification of 10.7 MHz IF signals in FM receivers, or for amplification of the inter-carrier sound signal in television receivers, are very suitable for the amplification of ultrasonic signals from a receiving transducer. ▶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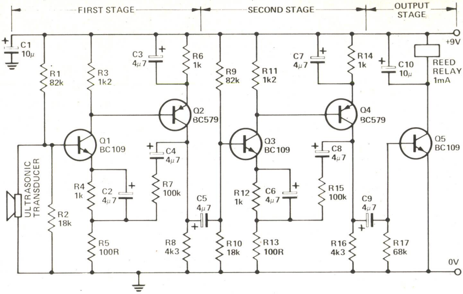

Figure 6. **An ultrasonic receiver circuit using discrete components. The reed relay closes when ultrasonic waves fall onto the input transducer.**

Discrete components

A five-transistor discrete component receiver is shown in Figure 6. Each of the transistors employed is a high-gain, low-noise, small-signal type of the appropriate polarity. Q1 and Q2 provide the first stage amplification and this is followed by an identical second stage, Q3 and Q4, while Q5 controls a sensitive reed relay. When ultrasonic waves of the correct frequency (25 kHz or 40 kHz) fall on the transducer, the relay will operate.

The transducer can be connected directly to the base of Q1, since it has a very high dc impedance and will not affect the bias applied to Q1. The gain of the first stage is determined mainly by R7 and R5 and that of the second stage by R15 and R13. Either R7 or R15, or both, should be reduced if the circuit becomes unstable due to a poor layout or if a high sensitivity is not required. When the distance between the transmitting and receiving transducers is quite small, it is possible to use only a single stage of amplification before the output stage.

When the 40 kHz voltage peaks across R17 exceed about 0.65 V, Q5 commences to conduct and only a little increase in the ultrasonic wave intensity will then cause the reed relay to close. Capacitor C10 smooths out the 40 kHz half-cycles of current passing through the reed relay.

It is important to note that a very sensitive reed relay must be employed in this circuit which closes with a current of no more than about 5 mA with a coil voltage of about 6 V. During the setting up of the circuit and when experimenting with it, it is instructive to insert a 10 mA meter in series with the reed relay coil. Although the reed relay can switch only a small current (perhaps 100 mA), this current can be used to perform any desired operation, including the control of a much larger relay.

TAB231 Receiver

Another receiver circuit for the control of a relay is shown in Figure 7. A TAB231 (SGS-ATES) or the equivalent, uA739 (Fairchild) or a similar device, is employed as a 40 kHz two-stage amplifier. Resistors R1 and R3 provide a bias for the non-inverting (+) input of the left-hand amplifier to which signals from the transducer are also fed. Capacitor C1 effectively ties the junction of R1, R2 and R3 to common (0V) as far as alternating voltages are concerned, so the resistor R2 appears as a load across the transducer terminals and broadens the frequency response of the transducer (see Figure 2).

The gain of the first 40 kHz amplifier stage is set by the ratio of R5/R4, but the other components in the feedback network reduce the gain at low frequencies. The output from pin 1 is fed directly into the non-inverting input of the second amplifier stage and also provides a suitable bias for this input. The second stage is of a very similar design to the first stage except that some component values are modified to reduce unwanted noise and low-frequency gain which can cause problems.

The output from pin 13 is fed through C7 to a diode pump circuit. The latter converts the 40 kHz waveform into a steady voltage which appears across the diode pump output capacitor C8 which has its upper end positive when the ultrasonic waves are present on the receiving transducer. Each 40 kHz input wave passing through C7 causes a small amount of charge to flow through D2 to the capacitor C8 which thus becomes charged.

▶

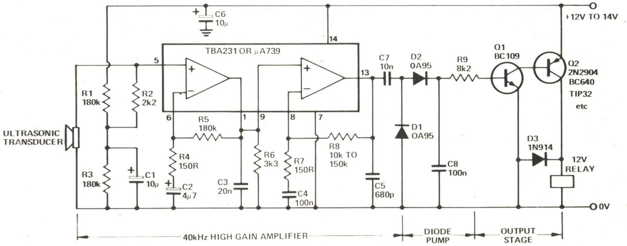

Figure 7. **Receiver circuit using the TBA231 or uA739 as a high gain amplifier.**

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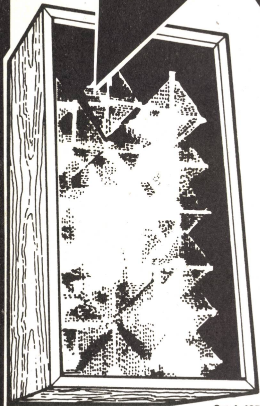

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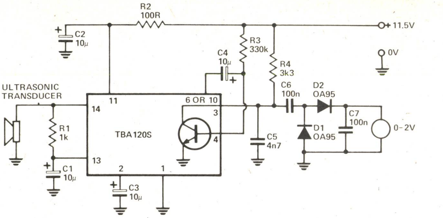

Figure 8. **A receiver employing the TBA120S as an amplifier and featuring a meter display.**

Charge from C8 passes through R9 and through the base-emitter junction of the high-gain transistor Q1; a collector current therefore flows in this transistor. The current flowing from the emitter to the base of the PNP output closes whenever ultrasonic waves fall onto the receiving transducer. The 2N2904 output transistor can switch a moderately large current, so a relay which requires a current of 150 mA or more can be employed. Such a relay can switch a substantial current through its contacts — perhaps 10 A in a 250 Vac circuit, so power levels of well over 1 kW can be controlled by this circuit directly.

The resistor R8 in Figure 7 may be adjusted to obtain the required gain. If the sensitivity is too high, spurious signals may cause the relay to close. In particular, the ringing of a telephone bell, even at a distance of some eight metres can cause the closing of the relay. The sensitivity can be reduced by reducing the value of R8. For some applications it is instructive to insert a meter (perhaps 100 mA FSD) in the 2N2904 emitter or collector circuit.

Transducers resonating at any frequency between about 20 kHz and 60 kHz may be employed in the circuits of Figures 6 and 7 with the component values shown. It is only in the transmitter circuits that component values must be slightly changed if transducer frequencies are altered so that the required frequency of oscillation is obtained.

TBA120S circuit

The circuit of Figure 8 shows how a Philips TBA120S device may be used as a 40 kHz amplifier. The TBA120S is intended for use as an IF amplifier and an output may be taken from pin 6 or pin 10 through a 10n coupling capacitor, as shown, to the base of an internal transistor which is used to provide more gain. In the circuit, R4 forms the collector load and the capacitor C5 was found to be needed to prevent spurious oscillation.

The output or the diode pump in Figure 8 is shown connected to a 2V FSD meter, but it could also drive a two-transistor output stage such as that shown in Figure 7. Indeed, the parts of the circuits shown in this article can be regarded as building blocks which the experimenter can connect together in many different ways, although care may be needed to prevent oscillation.

ULN-2212 circuit

A very simple receiver circuit for relay control can be made using one of the devices intended for use as a combined intermediate frequency and power amplifier (leaving any volume control circuit unused). The writer has used the LM1808, while the circuit of Figure 9 shows the use of a Sprague ULN-2212 device.

The section of the ULN-2212 intended for use as an intermediate frequency amplifier is used to amplify the 40 kHz signal from the ultrasonic transducer, the bias to the input pin 10 being applied through R1 from pin 11.

The output from pin 2 is coupled to the diode pump, D2 and D3, and the resulting positive potential is fed into the input of the power amplifier at pin 3. This power amplifier can pass enough current to control the relay connected in its output circuit (pin 7). As with the circuit in Figure 7, a diode is connected across the relay to shunt the reverse transient voltage produced when the relay coil current ceases to flow, since this voltage could damage the output device.

Although the circuit of Figure 9 is very simple, it is not so flexible or so sensitive as that of Figure 7.

The diodes shown in the diode pump circuits are germanium point-contact types (OA95), since these are switched to conduction by a potential of about 150 mV. Silicon diodes, such as the 1N914, can also be used in the diode pump circuits but they may not respond to weak signals as do the pump circuits using OA95s since they require about 0.65 V for forward conduction.

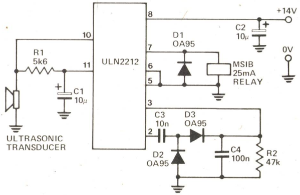

Figure 9. **This is one of the simplest possible circuits that will operate a relay from an ultrasonic transducer. The relay should be a sensitive type and may have whatever contact set is appropriate to your application.**

Applications

The receiver circuits of Figures 6 to 9 inclusive can be employed in simple remote control applications in which one wishes to be able to press a button on a small hand-held transmitter unit in order to cause a relay to close in some equipment up to about 20 metres away. Unlike light beams, ultrasonic communications links are almost unaffected by the presence of rain, fog, snow, smoke or dust. Such a link could, for example, be used to call a person working in a garden shed into the house.

If an ultrasonic transmitter unit is mounted on the front bumper of a car, when the driver reaches his home he can transmit a short pulse of ultrasonic waves to a receiving unit near his garage door which causes his garage ▶

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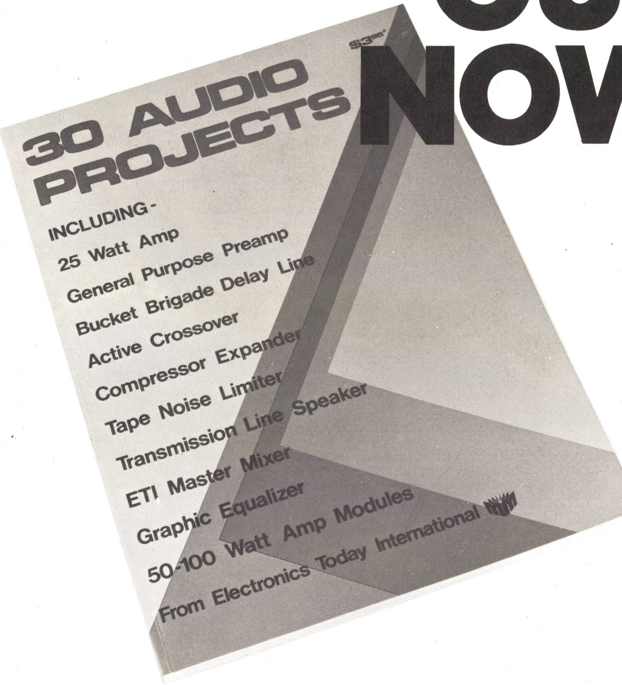

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door to be opened automatically by a motor, without the necessity for the driver to leave his vehicle. Similarly, he can close the garage door as he leaves home.

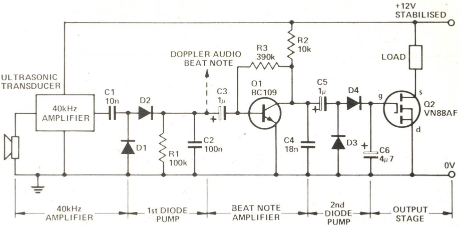

Figure 10. **Circuit of a receiver for a Doppler-type intruder detector.**

Ultrasonic links have been widely used for the remote control of television receivers, but they have now been largely displaced by infra-red links. The latter tend to be more complex than ultrasonic links, but they do offer the wider bandwidth desirable for the many channels of communication required to control a colour television receiver (which may possibly include a Teletext decoder).

If an ultrasonic transducer is placed in a sealed enclosure, such as the interior of a car or a refrigerator, a receiver unit fitted with a meter in its output stage can be moved around the outside of the enclosure to locate any small leaks in the sealing rubber. The ultrasonic waves can only escape from the interior through any such small leaks and this method of leak detection is generally much more convenient than, for example, waiting until it rains to see where the water enters one's vehicle!

The circuit of Figure 8, or the circuits of Figure 6 or 7 (if fitted with a meter output) are very suitable for this application.

Leaks in pressure or vacuum pipes generate ultrasonic waves which can be used to deflect a meter in a suitable receiver. Thus the leak can be located. Similarly, some types of electrostatic corona discharge produce ultrasonic waves which can be detected in much the same way. Generally however, it is better to convert the ultrasonic frequency into an audible frequency by a heterodyne technique, as discussed later.

A simple transmitter and receiver of the types discussed, operating at a fairly low gain, can be used as an intruder detector. If an intruder passes through the beam, the interruption of the beam operates a relay and this gives the required alarm. Ultrasonic systems have the advantage that the intruder cannot hear the signal. However, the Doppler system to be discussed is normally much more satisfactory than a simple transmitter and receiver, since the Doppler detector is triggered by movement anywhere in a protected room and it is not necessary for the intruder to actually pass through any given point in the beam. Nevertheless, a simple transmitter-receiver is adequate for the protection of a corridor or other narrow area through which an intruder must pass.

Another application for an ultrasonic transmitter-receiver circuit is the remote control of slide projectors. If one wishes to have remote control without connecting wires merely so that one can cause the next slide to be projected, a simple system like those described will suffice. If, however, one wishes to be able to return to an earlier slide and to be able to alter the focusing in either direction, then a four-channel link is needed. Multi-channel systems are most easily constructed using some of the special devices developed for television receiver control.

At one time, the police in certain countries used ultrasonic transmitters to switch on motorway warning lights for fog or ice by merely directing the beam at a receiver near the warning light without stopping their vehicle.

Another application is in vehicle safety belt security systems in which the safety belt emits an ultrasonic tone from a transducer fixed to it; the vehicle cannot be started unless the signal is being received by a transducer mounted near the windscreen. Slightly different frequencies cover the driver and front passenger seats.

Doppler intruder detector

A Doppler intruder alarm receiver circuit is shown in Figure 10. When used with one of the transmitter circuits discussed previously (which should be operated from the same stabilised power supply), the circuit can detect the slightest movement anywhere within a room of the size found in a normal house. The 40 kHz amplifier shown in block form may consist of the discrete circuit shown in Figure 6, up to and including Q4 (so that C9 of Figure 6 corresponds with C1 of Figure 10). Alternatively, the 40 kHz amplifier may consist of that shown in Figure 7, in which C7 corresponds to C1 of Figure 10.

The ultrasonic transmitter is placed in the same room as the Doppler receiver unit of Figure 10, but the two transducers should not be placed so that they directly face one another. The transmitted frequency is reflected around the room from wall to wall and some of the signal will be picked up by the receiver unit. If anything moves in the room, a Doppler-shifted ultrasonic tone will be reflected from the moving object to the receiver so that the two separate frequencies will be amplified by the 40 kHz input amplifier.

The output from this amplifier is fed to the first diode pump circuit so that the difference frequency or beat note is developed across C2. Objects which are moving fairly rapidly in the room develop a beat note in the audio frequency band which can be heard if the signals across C2 (Figure 10) are fed to an audio amplifier. More slowly moving objects develop sub-audio frequencies but the use of large coupling capacitors in the remainder of the circuit ensures that a response to either audio or sub-audio frequencies is obtained. Ultrasonic frequencies are shunted to common through C2.

The beat frequency is coupled by C3 to a single transistor difference frequency amplifier, Q1. Any residual 40 kHz frequency components are filtered out by C4 and the low difference frequency is passed to the second diode pump circuit. This circuit will develop an appreciable voltage across C6 only when a Doppler shifted signal is present at the input in addition to the transmitted signal. The presence of the Doppler-generated signal across C6 can be used to switch on the VN88AF power MOSFET output stage which allows a current to flow through the load and thus sound the alarm.

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Figure 10 has been included as an alternative to the two-transistor circuit of Figure 7. The output stage of Figure 7 can be used as the output of the Figure 10 Doppler receiver, and vice-versa.

The writer has also used a circuit of type shown in Figure 10 with a power Darlington output stage controlling a relay. The relay did not close if a person some four metres from the equipment remained absolutely still, but if he breathed in or out (even relatively slowly), the movement of his chest wall was enough to cause the relay to close without fail!

One of the problems with such extreme sensitivity is that of false alarms, since even the occasional false alarm in the middle of the night can cause a great deal of trouble! One should also remember that this circuit is sensitive to any stray ultrasonic frequencies such as the ringing of a telephone bell or even the rubbing of two surfaces together if they are near the transducers. If the transducer of the Doppler receiver of Figure 10 (or the transducer of any sensitive ultrasonic receiver) is tapped with the finger, a considerable response will always be obtained in either an output relay or output meter. It should be noted that a regulated power supply should be used for the Figure 10 circuit, otherwise stray changes in the power line voltage may give rise to false alarms.

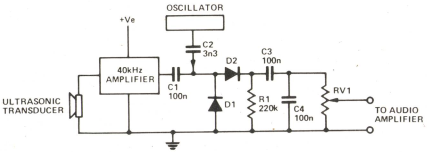

Figure 11. **Ultrasonic sounds can be rendered audible by 'heterodyning' the input to an ultrasonic transducer down to the audible frequency range. The frequency range covered depends on the particular transducer employed; i.e: a 25 kHz or a 40 kHz type.**

Bat detector

A 'bat detector' converts incoming ultrasonic waves into audio signals which can be heard. In order to construct a bat detector which will respond to a wide range of ultrasonic frequencies, an expensive ultrasonic microphone is usually needed. However, reasonable results can be obtained using a cheap ultrasonic transducer in the type of circuit shown in Figure 11. No transmitter unit is needed.

The 40 kHz amplifier can be the same type as that used in Figure 6 or Figure 7, its output being fed to the diode pump of the Figure 11 circuit. In addition, signals from an oscillator operating at a frequency close to the frequency of the incoming signals are fed through C2 to the same diode pump circuit. The oscillator circuit can be that of Figure 4, but the output from pin 3 is connected to C2 of Figure 11 instead of to the ultrasonic transducer shown in Figure 4.

The difference frequency between the incoming signal and the oscillator is developed in the non-linear diode pump circuit of Figure 11. The components C3 and C4 filter out the ultrasonic frequency signals and the difference frequency is passed to an audio amplifier through the volume control VR1. Any audio amplifier with a gain of the order of 50 is suitable (such as many of the integrated circuit audio amplifiers on the market). Either a small loudspeaker or an earpiece may be used to produce the audible noise.

Experimenting with a 'bat detector' circuit is of great educational value and makes one appreciate what a vast world of ultrasonic tones we are missing! If one rubs the palms of one's hands together or rubs any two suitable surfaces in front of the face of the receiving transducer, one can hear the rubbing noise, since such rubbing generates ultrasonic waves. Snapping a finger and thumb together or blowing air through one's teeth are other simple ways of generating ultrasonic waves.

The performance of the Figure 11 circuit does not vary very much as one changes from 40 kHz to 25 kHz transducers, although one is listening to different frequency bands in the two cases. In addition, it does not make much difference whether one has the oscillator operating above or below the ultrasonic frequency to which one is listening. Indeed, no oscillator is required when receiving the ultrasonic waves from rubbing two objects together since the range of frequencies generated by such objects beat with one another.

The oscillator is required when receiving a note from an oscillator connected to an ultrasonic transmitting transducer (such as the circuits of Figures 3 to 5). The use of a transmitter with the bat detector circuit of Figure 11 results in a clear note being produced which it is easy to pick out amongst the noise. The writer found that the note could be detected when the distances between the transmitter and detector were as much as 35 metres in the open air. The maximum distances indoors are greater, since there is less stray ultrasonic noise to interfere with the wanted signal. In particular, ranges in a corridor can be considerably increased by reflections of the ultrasonic waves from the walls towards the receiving transducer. A further increase in the range can probably be obtained by placing the transmitting transducer or the receiving transducer, or preferably both, at the focus of parabolic reflectors.

It is interesting to note that bats emit ultrasonic vibrations between about 25 kHz to almost 160 kHz, whilst small rodents can emit vibrations from about 90 kHz down into the audible range. Insects such as grasshoppers and some moths emit frequencies up to about 80 kHz — 100 kHz. Some of these vibrations can be detected by the Figure 11 circuit, but for optimum results a purpose-built bat detector costing about $1000 is needed. The writer has used the Figure 11 type of circuit to detect the ultrasonic emissions from young mice a few days old by which they communicate with their mother.

Conclusions

This article has been written to show the experimenter how he can use economical equipment for ultrasonic work. No attempt has been made to cover some of the more difficult aspects of the subject, such as voice modulation of ultrasonic waves for intercom systems or the measurement of distances by ultrasonic pulse techniques or the measurement of wind velocity. The aim has been rather to show what can be done easily by the use of simple circuits.

One can even use one of the circuits of Figures 3 to 5 inclusive to call a dog which has been trained to return to its master on hearing the ultrasonic tone, but it is advisable to use a relatively low frequency for this purpose (20 kHz to 25 kHz) to minimise air absorption and to use a frequency to which the dog is most sensitive. ●

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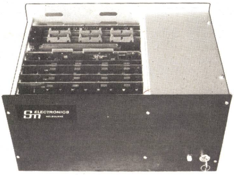

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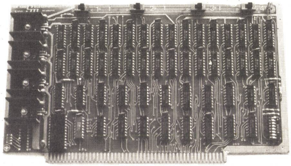

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80 X 24 VIDEO DISPLAY CARD.

Features:- on board Z-80 and CRT 5027 controller chips, parallel keyboard interface, 2708 driver chip, and 2708 character generator chip, special effects and extended character set available.
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Features:- memory mapped 1K board, with reverse video and cursor control. RCA video connector, plated through holes and solder resist mask.
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FLOPPY DISK CONTROLLER CARD

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Features:- controls mini and full size, single/double sided single/double density and all combinations of each. Crystal locked, PLL data recovery, Shugart/Remex compatible software (CP/M / SDOS) for above controllers available.
Price:- Kit $285. Ass $345

STANDARD EXTENDER CARD

Features:- double sided f/glass board, numbered test points reflow soldered.
Price:- Kit $33. Ass. $48

WIRE WRAP CARD

Features:- double side f/glass board, ground plane and supply rails run on both sides, 3M type connector patterns on top of board, provisions for regulators on all rails, holes are on .3'' pitch, by .1'' pitch.
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6800 PRODUCTS

6800 Extender Board **$33.** 6800 11-slot backplane **$36.** 6800 11-slot chassis, rack mount **$330.** 6800 Extender Terminator Board, **Kit $80. Ass $105.**

EPROMS AND RAM CHIPS

2708 450nS guaranteed **$12.** 2716 450nS single supply ex-stock **$47.50.** Hitachi 2114 low power 450nS **$7.50.** Hitachi 2114 low power 300nS **$8.50.**

DISK DRIVES

Shugart SA400 **$410.** Shugart SA801 **$710.** Remex 8-inch double sided **$795.**

DUAL 8'' DRIVE PACKAGE

Features:- contains dual 8'' single or double sided disk drives either Remex or Shugart. Inbuilt power supply, cooling fan, modular construction, keyswitch, fused on mains, all aluminium 19'' rack mount (10-½'' high).
Price:- single sided $1750. Double sided $1950.

EPROM SOFTWARE

1. Z-80 monitor in 2708 EPROM, has 16 functions, three versions available to drive TTY, TTY/VDU, KBD/VDU. **Price $25. 2.** ETI 640 video driver EPROM, makes the memory mapped video card look like a terminal, has XY cursor addressing, home clear screen. **Price $25.**
3. 6.25K Basic interpreter, in seven 2708 EPROMS, has trig functions, dimensions, command level input ability. EPROM resident at OC000 hex. **Price $180.**
4. Disk control EPROMS, contain I/O routines to handle our disk controller with CP/M, 2 EPROM set with second EPROM containing inbuilt video driver and I/O routines for all external devices like printers, terminals etc. **Price $50.**
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DISK SOFTWARE

CP/M version 1.4 customised for our controller. **$145.** CBASIC II **$125.** Wordmaster, wordprocessing package **$140.** TEX writer, letter and text formatter **$50.** CP/M user group library (33 vols) at **$12** per vol. RAM Diagnostic, reports errors and likely causes **$25.** Available on 8'' and 5-¼'' single or double density. Above prices are for 8'' disks.

64K DYNAMIC RAM CARD

200nS access time, bank select, wait states, 4116 RAMS.
32K — **kit $525. A&T $605.**
48K — **kit $670. A&T $750.**
64K — **kit $815. A&T $895.**

Z80 STARTER KIT

Hex key pad, hex address & data displays, 2 x S100 sockets, wire wrap area, PROM programmer, parallel port, Kansas City cassette interface, timer chip (Z80 CTC), 2K monitor PROM, monitor listing, 120 page manual, 2K RAM, 4K PROM.
KIT PRICE $350. A&T $420.

MPB-100 CPU BOARD

Z80 CPU Board with 2K single supply EPROM provision, power on jump, 4 MHz, front panel socket, wait state.
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2708 EPROM CARD

16K of 2708, 4K address boundary, 8 or 16K area required, wait states, plated thru.
KIT PRICE $98. A&T $128.

LA34 DECWRITER PRINTER/TERMINAL

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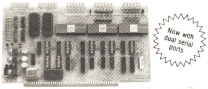
S-100 I/O PORT BOARD



DUAL SERIAL I/O CARD Features:- dual independantly controlled serial ports with TTY and RS232 outputs and inputs. Nine programmable parallel ports, crystal controlled baud rates fully buffered and address decoded. Plated through holes & solder resist mask.
Price:- Kit **$189.** Ass. **$225.**

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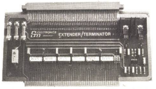
S-100 EXTENDER/TERMINATOR



EXTENDER TERMINATOR CARD — features:- true active termination of the bus with inbuilt extender connector on top of board, fused rails to extended board. Test points numbered, solder resist, plated through. Price:- Kit **$70.** Ass. **$90.**

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Desk top printer with 150 cps printing speed, 9 x 7 dot matrix, numeric key pad, tractor feed, RS232 interface, 132 characters wide, 110 to 9600 baud rate, 640 character buffer. **Price $3,000.**

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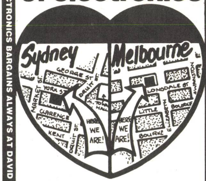

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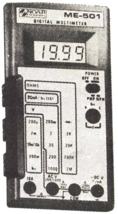

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Project 497

Three-way loudspeaker system — the 4000/2

Second in our line of quality hi-fi speakers for the do-it-yourself enthusiast.

David Tilbrook —

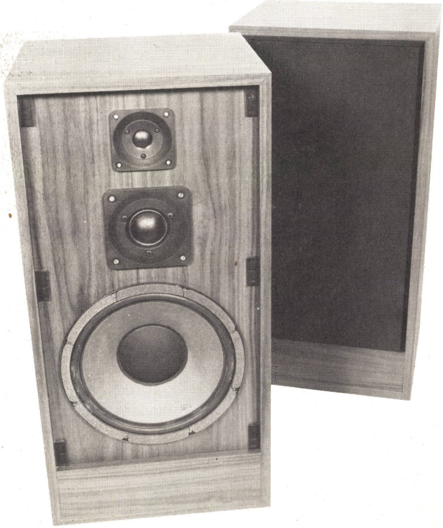
IN FEBRUARY THIS YEAR, we published the first in a range of loudspeaker projects, the ETI 4000/1. This was a four-way loudspeaker that used a separate driver and mid-range enclosure to cover the frequency range of 150 Hz to 700 Hz. The objective of this design was to remove the lower mid-range portion of the audio spectrum from the woofer so that the large cone excursions typical of bass reproduction would not cause intermodulation distortion by mixing with the mid-range. This technique works very well and the 4000/1 is capable of some of the cleanest sound possible with present technology.

There is, however, a demand for a lower-priced system and we are introducing the 4000/2 loudspeaker to meet this requirement. Much of the cost of the bigger loudspeaker was involved in the lower mid-range unit and its enclosure, and in the complexity of the crossover. The 150 Hz crossover point between the woofer and the lower mid-range necessitated the use of very large inductors and capacitors, and these are expensive.

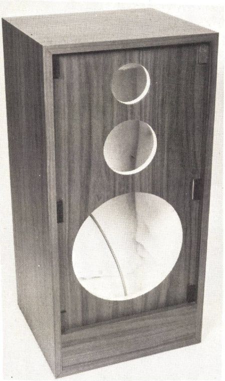
By eliminating the lower midrange unit and its associated hardware and using a more conventional design approach, we have been able to keep the cost of the 4000/2 to a minimum, while still achieving a loudspeaker capable of excellent results.

Like the four-way loudspeaker, the 4000/2 is housed in a sealed enclosure. Crossover points are at 700 Hz and 3 kHz, and the crossover is a 12 dB per octave constant-K design. (See "Principles and problems in loudspeaker design", published in ETI, Jan & Feb 1980.)

▶



View of the completed speakers, with and without the front grille. We secured the latter to the front baffle using Velcro strips stapled in appropriate positions.



The completed box, prior to mounting the drivers and crossover network. The box lining is placed in position after the crossover unit, tweeter and mid-range drivers are placed in position. The whole box is then stuffed with waste wool before mounting the woofer to the front baffle.

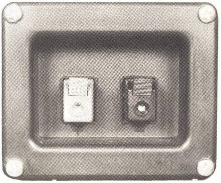
The drivers used here are part of the new range of Philips loudspeakers. We chose these drivers only after a thorough look at the price, availability and quality of drivers presently available in Australia. There is some relationship between power handling and price of a driver but there is *little relationship between sound quality and price*. Some of the best tweeters I have heard, for example, have been amongst the cheapest devices available. A complete set of drivers for this project will cost around $240, and at this price are a bargain.

The woofer used is the AD12250/W8. This has a free air resonance at 26 Hz and a power handling figure of 100 watts. When in its enclosure the resonant frequency rises to around 35 Hz, which is quite good!

The mid-range unit is the latest Philips dome mid-range, the AD02161/SQ8. This is a 50 mm diameter textile dome unit with its own mid-range enclosure as an integral part of the driver. The tweeter is a 25 mm diameter textile dome unit, the AD01610/T8. These three drivers were used in the earlier 4000/1 loudspeaker and the mid-range and tweeter units were shown to work well together with a crossover point at 3 kHz.

The big problem encountered in the design of this loudspeaker was the lower crossover point between the woofer and mid-range. The resonant frequency of the mid-range unit is approximately 350 Hz, so it should not be used much below 700 Hz. This enables the crossover to give 12 dB of attenuation at the resonant frequency. Unfortunately, this means that the woofer must handle everything up to 700 Hz and, ideally, should have a usable frequency response to 1.4 kHz. The AD12250/W8 doesn't have a response this good, but it can be made to operate satisfactorily up to 1 kHz, which is a reasonable compromise. Since the woofer is handling a good part of the mid-range spectrum, a substantial amount of cabinet damping is necessary, otherwise cabinet resonances will severely impair the mid-range performance of the loudspeaker.

The prototype loudspeakers were first lined with a double layer of speaker innerbond material, then completely filled with waste wool. As always, the exact amount of filling needs to be established by experiment. During the development of the 4000 range of loudspeakers I have had a good look at the types of innerbond material available and most of them are definitely not dense enough. Unless the quality of innerbond improves rapidly, you can safely consider carpet underfelt and fibreglass bats as suitable alternatives!

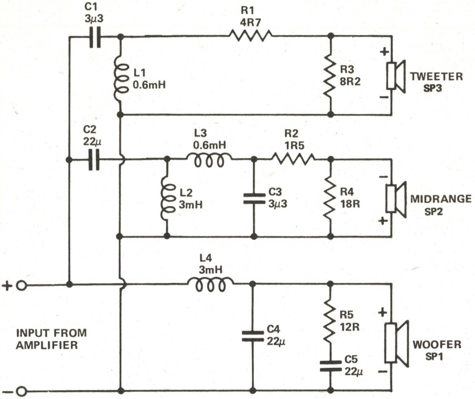


A close-up of the speaker connection terminals we used. This consists of two colour-coded spring-grip terminals mounted on a recessed plastic moulding. The assembly is screwed into a cutout in the rear baffle of the box.

Construction

If you are building the boxes yourself, rather than buying a complete kit, start by cutting the back, top, bottom and sides. The material used in the prototype boxes is 19 mm particle board and the finished units do not suffer excessively from panel vibration in use,

A group photo of the three drivers used in this system. Clockwise, from the left: AD02161/SQ8 dome mid-range, AD12250/W8 woofer and the AD01605/T8 tweeter — note that this last one is the alternative driver to that shown in the picture of the assembled speaker on page 51.



PARTS LIST - ETI 497

Drivers

SP1	Philips AD12250/W8
SP2	Philips AD02161/SQ8 or AD02160/W8
SP3	Philips AD01610/T8 or AD01605/T8

Inductors

L1	0.6mH,max.dc resist: 1 ohm
L2	3.0mH,max.dc resist: ½ ohm
L3	0.6mH,max.dc resist: 1 ohm
L4	3.0mH,max.dc resist: ½ ohm

Capacitors

C1	3u3 polycarbonate
C2	22u bipolar electrolytic, 50V
C3	3u3 polycarbonate
C4	22u bipolar electrolytic, 50V
C5	22u bipolar electrolytic, 50V

Resistors	all wirewound, 5%
R1	4R7, 5W
R2	1R5, 5W
R3	8R2, 5W
R4	18R, 5W
R5	12R, 5W

Miscellaneous

wire; one loudspeaker terminal block; particle board; screws; glue, etc; speaker grill cloth; innerbond; waste wool.

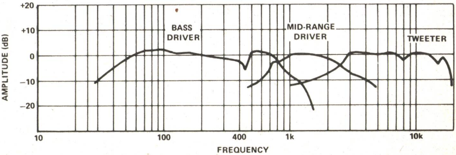
so particle board of this thickness should be sufficient for most purposes.

Apply a liberal quantity of Aquadhere, or a similar wood glue, to all the joints and screw the panels together. Let the glue dry and then line all the inside joints with a suitable sealent, such as caulking compound or Plastibond. Always use particle board screws or self tappers when working with particle board. Normal wood screws will not hold into the material properly.

For best bass performance it is important that the finished box is totally air tight, so eventually, the whole box will be sealed in this manner. This much of the sealing is best done now before the front baffle goes on.

Next, mount the spring terminals to the back panel. I used special loudspeaker terminals that are supplied fitted to a moulded plastic base. This simplifies the job of sealing the terminals considerably. The hole needed for the terminal base is rectangular but with rounded corners. Use a jig saw if you have one. If not, drill four holes to give the rounded corners necessary then join them up by cutting with a fret saw. Screw the terminal base into position then seal the inside of the cabinet between the timber and the base of the terminal block. Use Plastibond or Bostik for this as wood glue will not adhere to the plastic properly. An alternative way to seal the mounting terminal is to line the rim of the hole with plasticine and screw the terminals over the top. Be careful not to screw the terminal base down too hard as the plastic is easily cracked.

Cut out the front baffle so that it is a snug fit into the front of the loudspeaker. Cut four lengths of 25 mm square timber and screw these onto the inside of the sides, top and bottom, 38 mm from the front edge of the loudspeaker. The baffle is then glued and slid into the box so that it rests on the timber braces. Anchor the baffle board by screwing through it into the timber braces; 19 mm should remain between the front of the baffle and the front edge of the loudspeaker. This space will be taken up by the grill cloth former.. ▶



Hand-plotted graph showing measurements of the average response of the individual drivers in the completed system, measured in an 'average' living room. The 'dips' at the cross-over points "flatten out" in the overall response of the system since the contribution from each driver adds in these areas.

Glue the small 100 mm high wooden panel into position at the bottom of the box. In the 4000/1 loudspeakers there was a false bottom, leaving approximately 90 mm under the box in which to mount the crossover. In the interests of keeping the cost of this project to a minimum I have omitted the false bottom and the crossover is mounted on the inside of the box as is more commonly done.

The next stage of construction is to mount the tweeter and mid-range. First, solder lengths of speaker cable to each of the drivers so that there is enough cable to reach the bottom of the box. The tweeter and midrange units are supplied with their own mounting gaskets that ensure a good seal between the baffle and the drivers. Use Philips head or Posidriver type screws for mounting the drivers, this will minimise the possibility of slipping off the screw and possibly putting a screw driver through the loudspeaker cone.

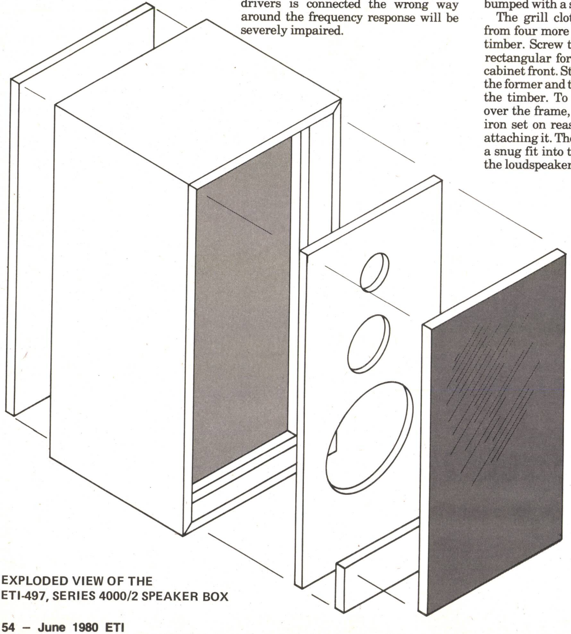
The crossover for the project will be manufactured by Philips and should be available through Philips retail outlets. The pc board on the front cover is the prototype unit and there may be some changes to the pc board layout to simplify manufacture, but the circuit will be the same. Should you decide to construct your own crossovers, the necessary components and the pc board overlay will also be available from Philips retail outlets. The inductors will need to be glued to the board with epoxy. Other than this, crossover construction should be obvious.

Solder the wires from the drivers to the crossover. *Be careful to ensure that the polarity of the wires to each of the drivers is correct.* If any one of the drivers is connected the wrong way around the frequency response will be severely impaired.

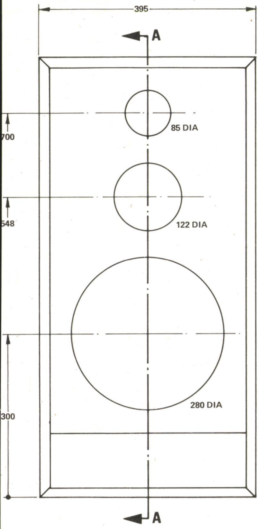
Solder wires from the terminals to the crossover, and mount the crossover to the bottom of the box with self tappers. Line the inside of the box with two layers of innerbond then stuff the whole box with waste wool. Some experimenting will be necessary to establish the optimum amount of stuffing. Finally, cut another piece of innerbond 450 mm square and place this in the box so that it is attached to the inside of the baffle around the rim of the woofer hole. This serves to keep all the stuffing away from the back of the woofer.

You will need to make a small hole in the innerbond for the cable to the woofer. Solder this to the woofer, then mount the woofer on the front panel. Once again, use Philips or Posigrip type self-tappers. The roll surround of the woofer is very easily damaged if bumped with a screwdriver blade.

The grill cloth former can be made from four more pieces of 25 mm square timber. Screw these together to form a rectangular former that fits inside the cabinet front. Stretch the grill cloth over the former and tack or staple the cloth to the timber. To make the cloth tighter over the frame, iron the cloth, with the iron set on reasonably low heat before attaching it. The finished grill should be a snug fit into the cavity in the front of the loudspeaker. ●



EXPLODED VIEW OF THE
ETI-497, SERIES 4000/2 SPEAKER BOX



NOTES
ALL OUTSIDE WOODWORK IS 19mm PARTICLE BOARD COVERED WHERE VISIBLE WITH THE DESIRED VENEER
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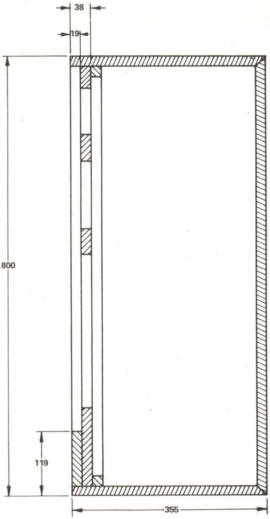

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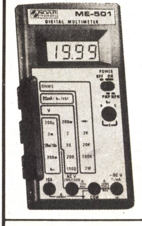

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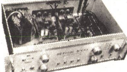

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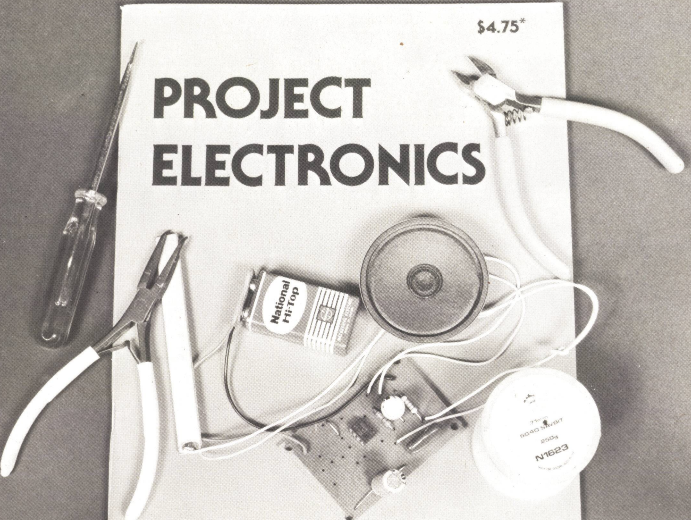

THIS BOOK has been specially designed and produced to meet the needs of newcomers to electronics. Students following the three-segment Industrial Arts syllabus at high school or embarking on the Electronics & Communications or a similar certificate course, will find the projects in this book an eminently practical introduction to the 'works' in electronics. Project Electronics has been a runaway success since it was first published. There are 26 projects included, many are readily available as inexpensive kits, and the book also provides advice on tools, identifying components, troubleshooting, how to solder etc. Available from specialist electronic suppliers or direct from the **ETI Subscription Department, 3rd Floor, 15 Boundary St, Rushcutters Bay NSW 2011** *for $4.75 plus 45 cents post and packing.*

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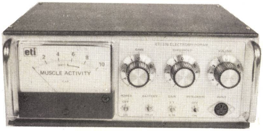

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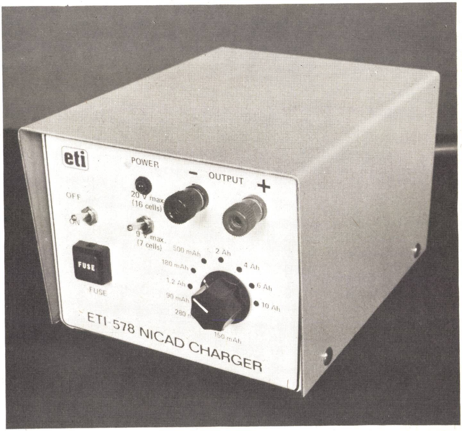
Project 578

Simple NiCad battery charger

Protect your investment in Nickel-Cadmium cells (NiCad for short) with this simple charger. It's very reliable, easy to build and won't ruin the cells by over-charging, which is a common cause of NiCad battery failure.

Design: **staff**
Article: **Andrew Kay**



PRACTICALLY EVERYONE who owns and/or uses battery driven equipment that is used regularly is aware of the staggering cost of the batteries that seem to need replacement with monotonous regularity. They seem to have the perverse habit of running flat at the most inconvenient time (Murphy's law notwithstanding): they are getting dearer all the time: their output voltage drops quite rapidly with discharge and last, but most importantly, they deteriorate almost as quickly on the shelf; as when they are in use.

Since it's not always practical to use mains-powered battery eliminators, one solution is a battery with a high 'ampere-hour efficiency'; that is, one whose voltage is much less affected by the discharge rate than the dry cell type. Also, it's handy if the battery can be recharged. The NiCad cell meets both these requirements. Although they are pretty pricey to start with, NiCad cells are capable (if treated properly), of up to *five hundred* charge/discharge cycles!

Just multiply the cost of your last battery replacement by five hundred and see the money that can be saved.

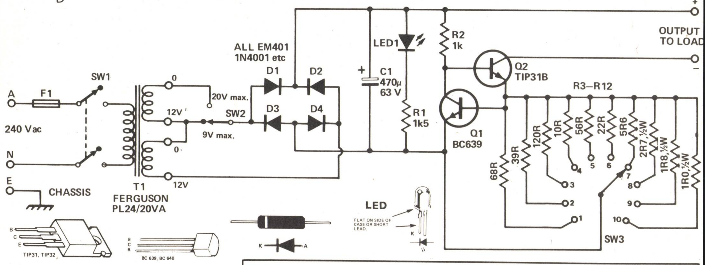
Care and feeding of NiCads

Now that you've been convinced of the economics of the matter, here are some basic but essential facts regarding NiCad cells.

The NiCad cell, like the lead acid unit, is a *secondary* cell or accumulator; i.e.: its chemical action is reversible. Passing direct current from an outside source (charger), converts electrical energy into chemical energy within the cell. The process is reversed when the cell is connected to an electrical load; the chemical energy stored within it during charging is converted to electrical energy which is dissipated by the load.

The NiCad cell needs a fairly constant charging current, this current being a function of the cell's capacity and the charging period. Cell capacity is expressed in Ampere-hours, abbreviated Ah, this being the current delivered by the cell, multiplied by the number of hours it will do so before reaching the discharged state. Take for example the 'AA' size NiCad cell which is equivalent to the U11 dry cell in dimensions and output voltage. It has a nominal capacity rating of 0.5 Ah; i.e: it will deliver half an amp for one hour; or 50 mA for 10 hours, 5 mA for 100 hours and so on.

However, there are physical limitations at higher current levels — one cannot expect to draw 50 A for 36 ▶



seconds or even 5 A for six minutes!

In fact, it is accepted practice to load the cells to only one tenth of the nominal Ah rating; i.e: if your circuit draws 50 mA average current, you should use at least a 0.5 Ah NiCad battery as a power source.

Similarly, to recharge a NiCad cell or battery to full capacity requires the same current-by-time multiplication sum. For example, to recharge an 'AA' NiCad cell it needs 0.5 A for one hour or 250 mA for two hours and so on.

Once again, owing to certain limitations — danger of cell rupture in particular — fast charging of our 0.5 Ah AA cell at 5 A for six minutes is definitely not on! Under certain circumstances NiCads can receive a 'rapid' charge and actually benefit, but perhaps we'll leave that subject till another time.

At this point we come to the basic problem of charging NiCad cells.

Danger of Overfeeding

Due to the nature of the NiCad cell, overcharging causes permanent damage. And it is quite hard to determine by ordinary means (such as a voltmeter) precisely where full charge occurs and overcharging begins. So it would seem that one must disconnect the cell from charging at, or before, the moment of full charge occurring!

Fortunately, there is a way around this problem which involves using a pre-determined low value of charging current. It is not a well known fact, but if the charging current is kept at one sixteenth of rated capacity then no permanent damage occurs, regardless of how long the cell remains on charge. In other words, you could leave your AA size NiCad cell connected to the charger for any convenient period, as long as the current was maintained at (500/16) mA

HOW IT WORKS — ETI 578

This charger consists of a step-down transformer, T1, a full-wave rectifier with capacitor-input filter (D1-D4 and C1), followed by a constant-current regulator involving Q1, Q2 and resistors R2 to R12, R3-R12 being selected by SW3 to provide the required charging current.

To understand how the constant-current regulator works, let's examine a simplified version of the circuit above - see Figure 1, below.

As the circuit stands, base current for Q2 will flow through R1 and Q2 will be turned on. Emitter current from Q2 will flow through R2, and if the voltage drop across R2 is above about 0.5 - 0.6 V, Q1 will turn on. Current through R1 will then be shared between the base of Q2 and the collector of Q1.

Now, with a load connected across the "constant current" terminals, collector current will flow through Q2 via R2. Thus, the voltage across R2 will attempt to rise. However, the base-emitter voltage of Q1 cannot vary greatly from a value of 0.6 V — this is a characteristic of the transistor. Thus, more base current will flow in Q1. This results in a greater collector current in Q1, which "robs" some of the base current from Q2, reducing its collector current. Thus, we have negative feedback and the current through the collector of Q2, which is also the load current, will settle to a value such that about 0.6 V is maintained across R2. Therefore, a constant current is delivered to the load, the value of which is entirely determined by the value of R2.

The power dissipated in R2 is kept quite low as the voltage across it will be no greater than about 0.6 V, thus low wattage resistors may be used.

In the project's circuit diagram above, Q1 and Q2 can be readily identified as they are identical with those in Figure 1. Base current to Q2 is supplied by R2 (a 1k resistor) and the output, or charging, current is determined by the resistor selected by SW3, from resistors R3 to R12.

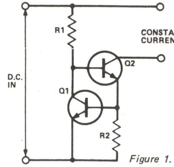


Figure 1.

PARTS LIST — ETI 578

Resistors	all ¼W, 5% unless noted
R1	1k5
R2	1k
R3	68R
R4	39R
R5	120R
R6	10R
R7	56R
R8	22R
R9	5R6
R10	2R7, ½W
R11	1R8, ½W
R12	1R0, ½W

Semiconductors

Q1	BC639
Q2	TIP31B
D1-D4	1N4001, EM401 or similar, 1A diodes
LED1	TIL220R or similar red LED plus mount

Capacitors

C1	470u, 63V electrolytic

Miscellaneous

F1	¼A fuse and fuse holder to suit (240 Vac rated)
SW1	DPST switch, 240 Vac rated
SW2	SPDT switch
SW3	single pole, 10 or 12 position switch
T1	Ferguson PL24/20VA or similar,12+12 V sec. at 800 mA.
pc board	ETI-578

Metal case to suit (we used a David Reid Electronics type, No.4., measuring 140 mm deep by 120 mm wide by 95 mm high); two "flat pack" heat sinks (Dick Smith H-3402 or similar) mains cable and three-pin plug; terminal block and cable clamp; rubber grommet; four rubber feet; piece of 1.6 mm thick cardboard; spaghetti sleeving; hookup wire; output terminals; solder lugs, nuts and bolts, two standoffs, Scotchcal front panel.

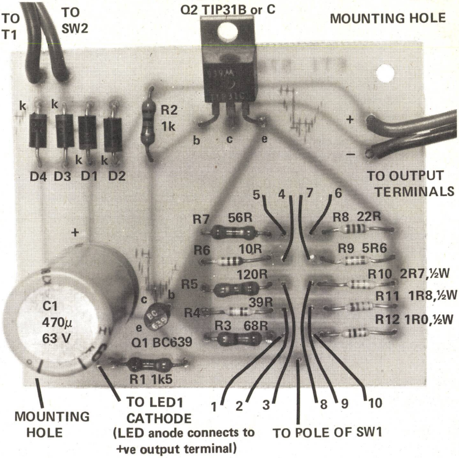
or 31 mA. Note that it would take at least 16 hours to fully recharge the cell.

The important thing of course is, you can't overcharge at this rate. The ETI-578 NiCad Charger is designed with this in mind. It provides a controlled charging facility for any one of ten types of commercially available NiCad cells. Table 1 shows the actual current ranges and the corresponding cell type numbers.

We used a simple voltage regulator and pre-determined values of current limiting resistors to get a ten-range constant current source. The output of the charger is very easily checked upon completion by connecting a current meter directly across the output. Remember that since this is a *constant current* source, the output current remains practically the same even if the output is shorted. The voltage goes up and down of course depending on the load.

One feature we have added is a switch (SW 2) to vary the input to the current regulator so that you can charge a string of cells, to a maximum of 16 (totalling about 20 V when charged).

Incidentally, the small sealed lead-acid batteries that have recently become available can also be charged using the ETI-578. These are generally available in ratings ranging from 2 Ah to about 9 Ah in 6 V and 12 V sizes.



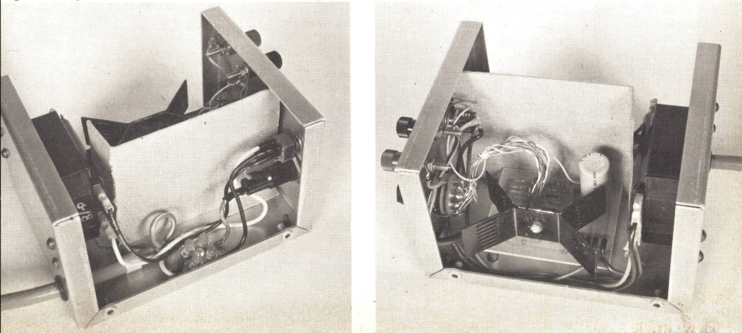
Component overlay for the pc board. Take care with orientation of the semiconductors.

Construction

This should be very straightforward. Layout is absolutely uncritical so you can use any available case or box. We have not included any constructional details on suitable connectors between the output terminals and the cells because in most cases connection can be made via flying leads to the battery holder in the equipment itself.

Having collected all the necessary parts, start by laying out all the major components in position in the box. A little effort at this stage can save a lot of teeth-gnashing, filing, drill-snapping and other time wasting later on. Using a fine felt pen or soft lead pencil mark the holes for *every* chassis-mounted ▶

Internal views of the completed project. Note that a 1.6 mm thick cardboard 'divider' separates the mains wiring from the other components as a safety measure. It stands the full height of the chassis and may be glued or bolted in position. The view at left shows the general arrangement of the mains wiring (see also the diagram over the page). Sleeve all exposed connections. Use a rubber grommet at the mains lead entry, then a cable clamp and two-way terminal block. The earth lead is longer than the other two and is secured under a bolt used for it alone. The picture at right shows the pc board wiring to the major components.



component. Check that adequate clearance is allowed for later wiring and access.

One important point; keep all mains wiring to one side of the layout and use the following:-

- a suitable anchor for the mains cable,
- an insulated terminal block, and
- a fuse with fuseholder

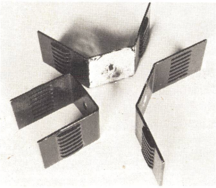
Having marked all the hole positions, drill and shape each one as necessary; remove all burrs and stray bits of metal, then check that all components fit properly before installing them.

After all panel-mounted parts are mounted, with the exception of the printed circuit board, assemble the pc board components. Fit the pcb-mounted wires (twelve for the range switch and one for the front panel LED). Check the polarity of the four rectifier diodes as well as the 470 uF capacitor.

Fit the printed circuit board into place using stand-off pillars. Identify the slider contact and the No. 1 position of the switch and connect the switch wiring starting at number one through to ten. Check the wiring, range by range, after you have finished.

When fitting the heatsink to the power transistor Q2, use a little silicon grease smeared on the contact surfaces; failure to do this may cause the transistor to fail on the higher ranges.

Fit the mains cable, terminal block, mains switch, and the fuse. Identify the earth lead and make a secure connection to the metalwork of the case.



The heatsink we used for Q2 was made up from two 'flatpack' heatsinks, Dick Smith No. H3402, bent as illustrated and mounted back-to-back on the transistor. This ensures they fit in the case. Use plenty of silicone heatsink compound to get good thermal conduction. The unmodified heatsink is shown at lower left.

Check this connection to the earth pin on the plug with a multimeter. Also check the active and neutral wires from the transformer to the mains plug.

Powering up

When all wiring is complete, insert a 250 mA fuse into the fuseholder and apply power. The LED should glow and you should be able to measure about 17 Vdc across C1 with SW2 in the "9V max." position and about 34 Vdc with SW2 in the "20V max." position. The reading should be within about 10-15%, if not, switch off and check your wiring immediately.

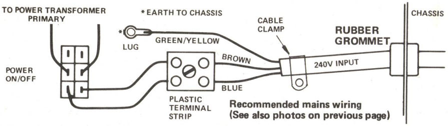
Assuming that everything is OK and your charger has not vaporised in the first five seconds carry out the following functional checks:

- connect a multimeter across C1 and short the output terminals while observing the meter reading. This should change only slightly, no matter which range has been selected. Typically, with SW2 on '20 V max.' on the 10 Ah range, the readings should be about 34 V with the output unloaded and 27 V with it short circuited. Switch off after this test.
- Set the meter to read current and connect it across the output, positive lead to positive terminal. Set the charge range switch to position 1 and the meter to a suitable current range. Switch the charger on. Check the reading against the figure given in Table 1. Repeat this check range by range, not forgetting to change the meter ranges of course!

If most of the ranges check out OK (within 10%) but one or two are a long way out, it's most probably caused by an incorrect value series limiting resistor (R2 to R11).

If the first two or three ranges are fine but the output is insufficient on the higher ones, either Q1 or Q2 is faulty. Finally, short the output, switch on, and leave running for a few minutes. Test the temperature of Q2 by placing your finger tip against the body of the transistor. If an imprint of the manufacturer's name is left in your flesh, overheating is indicated! Check that the heatsink is attached tightly to the transistor.

When connecting up the unit for use do not forget to observe correct polarity; the positive terminal on the charger connects to the positive on the battery, the negative charger terminal to the battery negative. ●



Recommended mains wiring (See also photos on previous page)

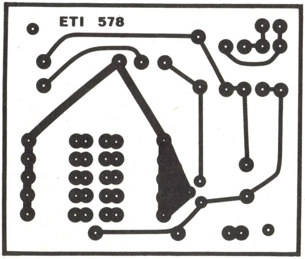


TABLE 1

Position	Resistor	Current	Cell type and capacity
1	R3	9 mA	150 mA hour Button cell
2	R4	17 mA	280 mA hour Button cell
3	R5	5.5 mA	90 mA hour, PP3
4	R6	75 mA	1.2 A hour, PP9
5	R7	11 mA	0.18 A hour, AAA
6	R8	31 mA	0.5 A hour, AA
7	R9	125 mA	2 A hour, C
8	R10	250 mA	4 A hour, D
9	R11	375 mA	6 A hour
10	R12	625 mA	10 A hour

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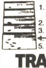

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All new, all high quality parts, samples, specials, end-of line, useful components, incl semiconductors, transformers, resistors, capacitors, pots, IC's switches, relays etc. etc. etc. WORTH $$$$$ Over 2Kgm weight, size approx 11"x7"x6"

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MAL'S GOODIES

MAGNETIC CB AERIALS	only	$10·00
DC Filter CHOKES	For Car Radio cassette, CB	$1·50
5ft FIBERGLASS WHIPS	Now, build your own aerial etc for CB or Ham radio etc Metal bases to suit $1·20	$1·00
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IGNITION FILTER KIT	Suit CB or car stereo, 12v line filter kit.	$2
1KW CB/HAM TVI FILTER	New, were $29·50, easily fitted, only	$15
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100M rolls of Heatshrink	10mm diam	$5
CB XTALS	All channels, TRANS/RECEIVE per pair	$3
4 Pole 6 Pos. SWITCH	OAK rotary wafer sw.	$2·25
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24V DC REED RELAY	PCB mtg. 2 pole	$1·50
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2W+2W Stereo AMP	2 x LM-380 Vol, Bass, Trebl	$4
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500-Asst. ½W RESISTORS	LUCKY DIP	$2
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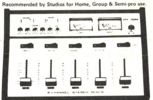
5CH STEREO AUDIO /MIKE MIXERS

Recommended by Studios for Home, Group & Semi-pro use.



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3v, 6v, 9v 50mA out at full sunlight

Size 104 x 144 x 13mm without reflectors!

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BUY 1 AT REGULAR PRICE GET 2nd ONE OF SAME NUMBER FOR ONLY 1¢

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2	20 ASST. POTS	Std volume, ganged, switched, dual etc.	$2·00	40 for	$2·01
3	4mm Stacking BANANA PLUG	No soldering needed–spring-loaded terminal.	ea 75¢	2 for	76¢
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5	1000uF 63vw Pigtail ELECTROS	New Elna caps	$1·30	2 for	$1·31
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9	5xTO-3 MOUNTING KITS	Comprise mica washer, insul. bushes + screws, nuts	$1·00	10 for	$1·01
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20	5WATT W.W. RESISTORS	0·51, 0·68, 0·75, 1·5, 1·8, 2·2, 2·7, 3·9, 4·7, 27, 47, 56, 68, 82 OHMS	ea 40¢	2 for	41¢
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26	VALVE OUTPUT TRANSFORMER	Popular replacement	$2·00	2 for	$2·01
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30	NIXIE TUBES-GRIII OR ZM-1000	0-9, 90v oper. last few avail	$2·50	2 for	$2·51
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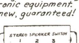

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Select from 7 combinations 3 speaker systems individually or altogether – with screw terminals

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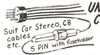

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5 PIN with fuseholder

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Interchangeable pins, colour-coded leads, with instructions

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Wide band RF amp improves AM/FM radio reception like you wouldn't believe! G'TEED

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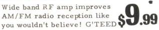

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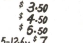

125w illustrated

All are compatible, easy to use, fully assembled and tested. Send 22c stamp for full specifications.

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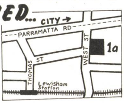

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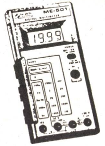

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From
$69.00
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ME-501B
Same as ME-501A plus continuity checker.

DIGITAL HANDHELD MULTIMETER . . .

Ushers in a dynamic generation of multimeters

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Accuracy - 0.8%
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CURRENT: DCMA - 200u-10A
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- 30 AWG wire
- Daisy chain or point-to-point
- No stripping or slitting required—just wrap
- .025" square posts
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- Includes 50 ft. wire

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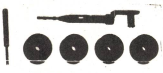
R-JW-Y	Yellow	50 ft. roll	
R-JW-R	Red	50 ft. roll	

JUST WRAP™ Unwrap Tool $3.81



JUST WRAP™ Kit

- 50 ft. ea.: blue, white, red, yellow wire
- JUST WRAP Tool
- Unwrapping Tool

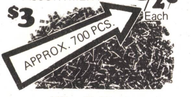
JWK-6 . . . . $32.15

Resistor

ASSORTMENT

$3

Less Than **1/2¢** Each



½lb - ½ Watt

We have several million resistors. They are ½ watt carbon film. Rather than count them we are weighing 'em out by the ½lb, average about 700 pieces, making the price per resistor less than ½ cent each. A great way to build up an inventory for your work bench. A large number of mixed values.

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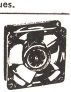
Popular fan. Standard size 4.68" square. 110 or 240 volt. $22.50 incl. tax.

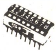


DIP SWITCHES

(On-Off Contacts)

4 Positions	$1.35
6 Positions	$1.60
8 Positions	$1.90

inc. tax



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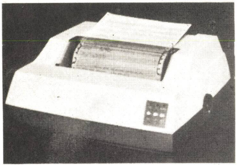
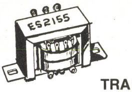


ITOH
Model 8300
$915 inc. tax

This 80-column printer provides quiet operation, making it suitable for use in offices, classrooms and homes. Specifications include 125 cps, 60 lines per minute, paper loading from bottom or rear and Centronics-compatible, parallel interface.
A bidirectional, dot matrix impact printer with a print head designed for 100 percent duty operation, assuring a print life that exceeds 100 million characters. The precision sprocket-feed mechanism permits printing forms from 4½ to 9½ inches wide. A 96 ASCII character set prints in upper and lowercase with the added capability of producing double-width fonts in boldface. The vertical format unit provides preprogrammed/ programmable tab positions, top of form and bottom of form for complete formatting capabilities.



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$3.80 ea. 10 up $3.34 ea.

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EXTRA SPECIAL

50 Electrolytic Capacitors from 1 uF to 4.700 uF.

$3.00 per pack.

DIAL DESK TELEPHONE

Only $8.50 each.
2 for $16.

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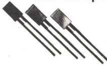

70c
Pkg. of 2

High-brightness. Can be stacked vertically or horizontally. Max. forward current: 30 mA. Typical forward voltage: 2.5.

276-070 Red	2/70c
276-071 Green	2/70c
276-072 Yellow	2/70c

SPECIAL

100 mixed disc ceramnic capacitors $1.50 pack.

50 polyester capacitors, mixed values $2.00 pack.

ELLISTRONICS NOW STOCK MOTOROLAS NEW KIT EXPANSION PRODUCTS (MOKEP). This range includes an adaptor/mother board, MEK 6800 AB, which accepts the D.2 Board and provides slots for five MOKEP boards.
Boards currently in stock are: MEK 68 R2, CRT Interface (VDU). Features: Software programmable; Line and Character Formats, 16 lines of 32, 16 lines of 64, 20 lines of 80, 20 lines of variable length. Up to 165 characters, Standard Video or TTL output, 1K Bytes of screen RAM expandable to 4K Bytes, CRT Bug to replace J Bug.

MEK 6802 D3	**$201.25**
MEK 68 RR	**$192.05**
MEK 68 R2	**$276.00**
MEK 68 R2M	**$276.00**
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ETI 466 300W POWER AMP

All components in stock

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BD 140	**40c**
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SPECIAL - SLIDE POTS

20K C 45mm	30c ea.
25 C 45mm	30c ea.
100K A 45mm	30c ea.

ROTARY CARBON POTS

20K A Dual	50c ea.
50K C Single	30c ea.
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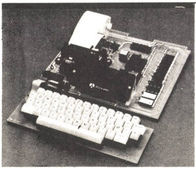

AIM 65

AIM 65 is fully assembled, tested and warranted. With the addition of a low cost, readily available power supply, it's ready to start working for you. It has an addressing capability up to 65K bytes, and comes with a user dedicated 1K or 4K RAM.

- **Thermal Printer**
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- **Proven R6500 Microcomputer System Devices**
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- **ROM Resident Advanced Interactive Monitor**
- **Advanced Interactive Monitor Commands**

$517.50 inc sales tax
$450 tax exempt

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OF PROJECT ELECTRONICS KITS

SAVE UP TO 53%!

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K-2043	**Heads/tails game**	$3.50	$2.45	$1.05	30%
K-2044	**Two Tone Doorbell**	$4.50	$2.95	$1.55	34%
K-2045	**500 second timer**	$4.50	$3.50	$1.00	22%
K-2047	**Morse Practice set**	$3.50	$2.45	$1.05	30%
K-2048	**Buzz board**	$3.90	$2.50	$1.40	35%
K-2061	**Basic Amplifier**	$5.50	$4.50	$1.00	18%
K-2062	**AM Tuner**	$6.50	$4.50	$2.00	30%
K-2063	**Bongos**	$5.00	$3.95	$1.05	21%
K-2065	**Electronic Siren**	$5.50	$4.50	$1.00	18%
K-2066	**Temperature Alarm**	$4.90	$2.90	$2.00	40%
K-2067	**Moisture Meter**	$4.90	$2.90	$2.00	40%
K-2068	**LED Dice**	$5.90	$5.00	$0.90	15%
K-2072	**2 Octave Organ**	$8.50	$4.00	$4.50	53%
K-2511	**Battery Saver**	$3.90	$1.90	$2.00	51%

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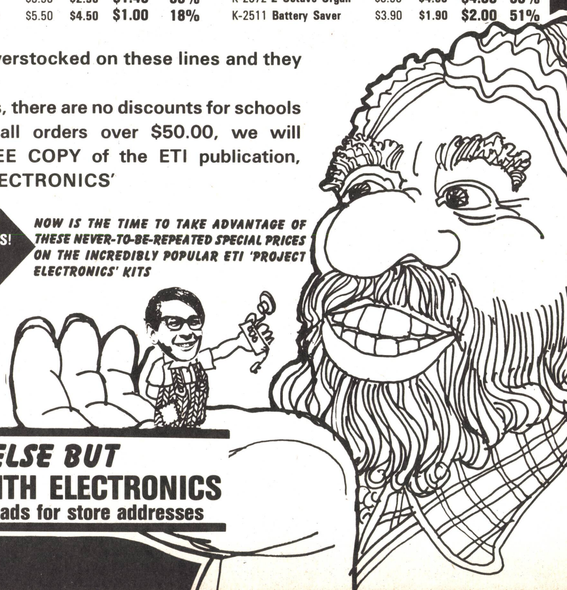

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Project 681

Programmable character generator for your S100 system

Craig Barratt

Add creativity to your computer! Another super project in our S100 bus computer series — this PCG teams with the popular ETI-640 VDU.

NOW THAT you have had your ETI-640 VDU for a while and can write characters anywhere on your monitor, wouldn't it be nice to be able to create your own characters and use these at will?

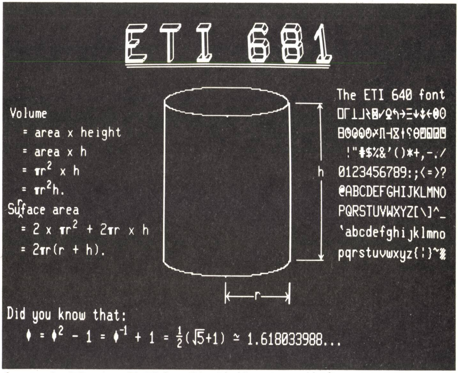
Well, we thought that this would be a great idea and after saying the right incantations a programmable character generator appeared.

It was soon discovered that the board also contained a logic probe for debugging and fully implemented joysticks for that once dreamed of analog input. And the people were happy. Well, you may ask, who would want a programmable character generator? I could just as easily ask who would want a microcomputer in their bedroom!

The PCG is in fact a very useful device when used in conjunction with the ETI-640 VDU. The most obvious use is to simply write a new character set into the PCG and use the VDU as you would normally. Instead of the usual characters appearing on the screen, the characters which you created would appear instead. This concept may be extended simply to creating special character sets for programming languages (APL requires a special character set), or having realistic aliens and starbases in your next game of Startrek. You might even play a chess game with the screen really looking like a chess board with recognisable pieces on it.

Besides passively generating character sets for use by programs, you can have programs change characters as you want. This means shapes can be moved across the screen and very realistic games can be produced.

So a PCG will let you win Wimbledon and destroy the enemy tanks — all from your own bedroom!



```
                 ETI 681

                                        The ETI 640 font
Volume                                  ΠΓ⊥┘⌇⊠⁄♀↰→≡↓↕←⊕0
  = area x height                       ⊟⊚⊚⊚⊗×Π⊣⊠↕⸮⊖⊡⊡⊡⊡
  = area x h                             !"#$%&'()*+,-./
  = πr² x h                          h  0123456789:;<=>?
  = πr²h.                               @ABCDEFGHIJKLMNO
Suface area                             PQRSTUVWXYZ[\]^_
  = 2 x πr² + 2πr x h                   `abcdefghijklmno
  = 2πr(r + h).                         pqrstuvwxyz{¦}~▒

                     r

Did you know that:
  φ = φ² - 1 = φ⁻¹ + 1 = ½(√5+1) ≃ 1.618033988...
```

An example of the range of 'tricks' possible with this programmable character generator

'Just one more toy' I hear all the purists say. Well, there is something in it for you purists too. With some good driving software you can use the PCG for x,y graphics with the joysticks as analog input, but more about this later.

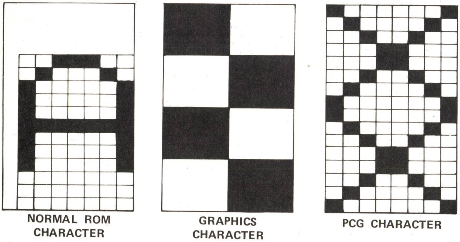
Features

Apart from being able to program up to 128 characters with the PCG, you can still use all the 128 characters available from the ETI-640. For each of the 1024 characters on the screen you can select whether it is a PCG or a ROM character. Of course, inverse and flashing characters (PCG or ROM) as well as chunky graphics, are still available on the ETI-640 VDU.

As shown in the accompanying diagram each of the 1024 characters on the ETI-640 screen consists of a matrix of bits — 16 bits high and eight bits across. So that characters are not pushed together, gaps are left around each one. Thus, a normal character from the ETI-640 actually sits in a smaller matrix of 12 bits high and seven bits across. The space around this smaller matrix appears black on the screen and is the gap separating characters.

When chunky graphics appear on the screen they completely occupy the 16 x 8 matrix and thus they can run together allowing unbroken lines and pictures to be drawn.

A character created by the PCG gives ▶



NORMAL ROM CHARACTER

GRAPHICS CHARACTER

PCG CHARACTER

Figure 1. **The character and graphics matrixes for the ETI-640 VDU compared to the 16 x 8 matrix of the ETI-681 programmable character generator.**

you the best of both worlds. With the PCG you can program every bit in the 16 x 8 matrix. Thus you can get the same definition as with normal characters but PCG characters can run together, like graphics characters.

The PCG occupies 2K of processor memory, which is located using an on-board DIP switch. This amount of memory is required since each character requires 16 bytes to define and 128 characters can be programmed. The representation of a PCG character is shown in Figure 2.

LOW NIBBLE	BIT NUMBER							
0	7	6	5	4	3	2	1	0
1	7	6	5	4	3	2	1	0
2	7	6	5	4	3	2	1	0
3	7	6	5	4	3	2	1	0
4	7	6	5	4	3	2	1	0
5	7	6	5	4	3	2	1	0
6	7	6	5	4	3	2	1	0
7	7	6	5	4	3	2	1	0
A	7	6	5	4	3	2	1	0
B	7	6	5	4	3	2	1	0
C	7	6	5	4	3	2	1	0
D	7	6	5	4	3	2	1	0
E	7	6	5	4	3	2	1	0
F	7	6	5	4	3	2	1	0

Each row of a character is one byte of memory. The most significant bit (bit 7) is the left hand bit as it appears on the screen, right through to the least significant bit (bit 0) which is the right hand bit as it appears on the screen. The top row of a character has a low nibble address of 0, the second has an address of XXX1 (hex).

Since each character occupies 16 bytes of memory, for a PCG starting at hex 'F800', character '00' in the PCG may be found at location hex 'F800'. Similarly, character '01' in the PCG may be found at location hex 'F810', character '02' at location hex 'F820' and so on. To convert between a character number and a PCG address, simply put a zero onto the end of the character number (in hex) and add the new number to the base address of the PCG. For example, character hex '5B' will be found at location hex 'FDB0' in the PCG, since hex 'FDB0' equals hex 'F800' plus hex '5B0'.

If you recall, there are two bits in the function block of the ETI-640, the flashing bit and the graphics bit. Using these bits you can select whether each character on the screen is flashing or graphics. The PCG adds a third bit to the function block of the ETI-640. Setting this bit low will make that character a normal (ROM) character. Setting it high will make that character a PCG character. The graphics and flashing bits operate as usual.

The Joysticks

Up to four joysticks may be connected to the PCG. The joystick circuitry is totally independant of the PCG's character generation. The joysticks are I/0 oriented while the PCG is memory-mapped.

A joystick consists of two potentiometers, one varying with vertical movement of the joystick paddle and the other with horizontal. Thus, up to eight pots may be connected to the PCG. The lines that interface to the pots are known as channels and eight of these inputs are available on a DIP socket on the PCG board.

The processor controls the joysticks through one I/0 port. To get the value of a given input channel the processor writes out the channel number to the joystick port. This initiates the timing cycle and the top bit of the input port goes low when the conversion is complete. The remaining seven bits of the input port are the converted value. The joystick circuitry in fact has other goodies built in, but more about this later.

The logic probe

A logic probe has been included on the board to aid in the service of this card and others. Two LEDs, red and green, indicate high and low levels respectively. If the logic probe is connected to a tri-state signal, the LEDs will flash slowly. This means the probe will give responses in the following way:

Condition of input	Logic probe output
High level	Red LED lit, green LED out.
Low level	Green LED lit, red LED out.
Tri-state level	Green and red LEDs alternately flashing.
Pulse train	Green and red LEDs both partially lit.

When looking at a pulse train, the brightness of each LED approximately corresponds to the time for which the pulse train is in that state. For example, a bright red LED and a slightly lit green LED means the input is mostly high and pulses low for short periods of time.

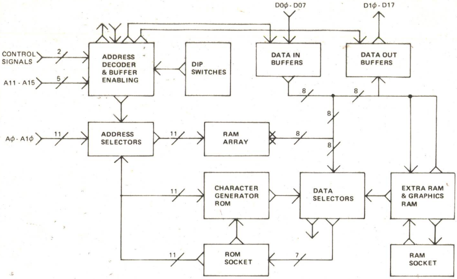
Construction

Now that you are convinced that you "just gotta get one", the next step is to get the parts and build up a board. Before you rush out and buy the parts, do yourself a favour and give this section *a good read.*

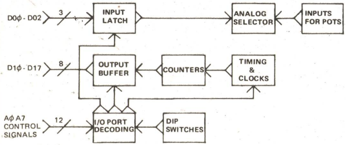
A good place to start would be the printed circuit card. Due to the large number of holes that need plating through, and the number of tracks that connect to chip pins on the top side of the board, using a plated-through hole board is strongly recommended. Such boards will be made available through Applied Technology we understand. For those incorrigible diehards who want to do it the hard way the PCG pc board patterns are not printed in this magazine. Don't despair! Send a *large* stamped, self-addressed envelope to 'PCG PCBs', ETI Magazine, 15 Boundary Street, Rushcutters Bay, NSW 2011 and we will send the patterns back.

If you are making your own printed circuit board you should start by soldering links through the board in positions which will be later covered by ICs.

The board has been carefully designed so that as few tracks as possible pass between IC pins on the



BLOCK DIAGRAM OF THE PROGRAMMABLE CHARACTER GENERATOR



BLOCK DIAGRAM OF THE PCG JOYSTICKS

solder side. Despite this, you should take care with each joint, watching out for dry joints and solder splashes.

There are two chips that you don't have to buy when you build the PCG. These are ICs 7 and 13 which are a 2102 RAM and the character ROM respectively. These come from the ETI-640, where they live under the alias of IC 22 and IC 4 respectively. DIP-to-DIP leads connect DL1 to the ex-IC22 and DL2 to the ex-IC4 sockets on the ETI-640, but more about this later.

Construction should commence with the insertion and soldering of all IC sockets, if you are using them. If you are not using sockets for the ICs you should still have sockets for the DIP-to-DIP leads, DL1, DL2 and DL3. Use a three-pin Utilux socket, ETI-632 VDU style, for CN1. Also solder in the DIP switches, DS1 and DS2.

All the resistors should be inserted next, followed by all the capacitors, except C21 whose value depends upon the value of the joysticks used. Note the polarity of C1, C2, C3 and C21 (when inserting them). The diodes and transistor are soldered in next, again noting polarity, followed by the potentiometers RV1 and RV2 and finally the heatsink with IC34.

Note that RV1 and RV2 are multiturn trimmers. These are used to set up the joysticks and it was decided that multiturn trimmers would make setting them up a lot easier.

Choosing components:

Some of the components used will vary from PCG to PCG (if more than one person builds one). These variations are:

1) If you are connecting the PCG to a processor board which has an inverted data bus (such as the KT9500), ICs 2, 19, 20, 21, 22 and 27 will have to be 74LS368s instead of the 74LS367s as specified in the parts list.
2) The value of C21 depends on the value of the joysticks used. Choose an appropriate value from Table 1.

If the value of the joystick that you are using is not in Table 1 then simply apply the magical formula provided.

VALUE OF RV1/RV2	VALUE OF C21
5k	330n
50k	33n
100k	18n

MAGIC FORMULA

$$C21 = \frac{1.75}{R_p + 0.3}$$

C21 is the value of C21 in μF
R_p is value of the pots in the joysticks, in kohms.

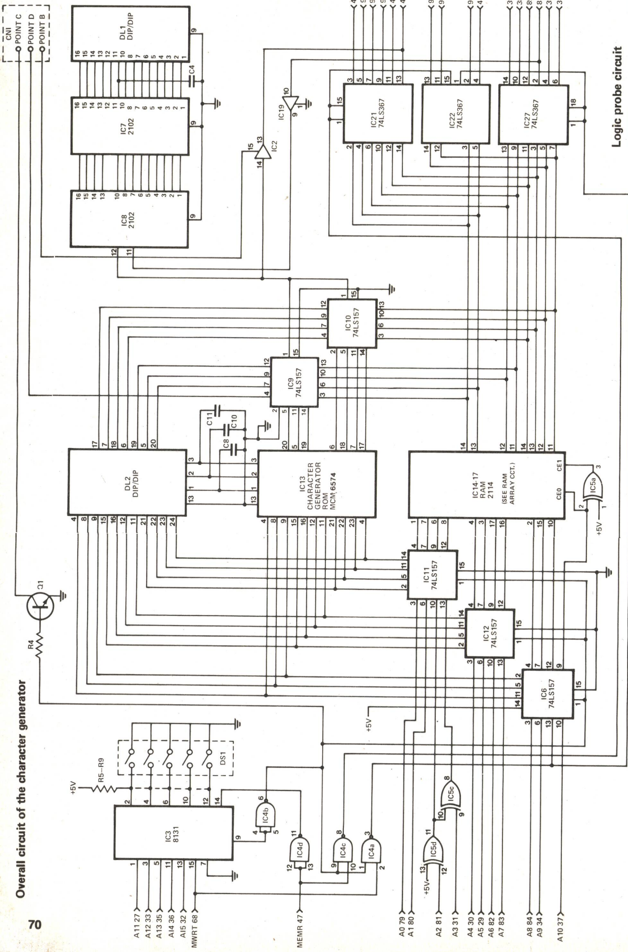
TABLE 1

Before inserting any ICs it is a good idea to apply power to the board and check the output of the 5V regulator. When this voltage is correct, solder or plug in the ICs and, besides interfacing the PCG to the ETI-640, construction is complete.

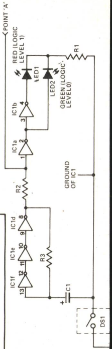
Before interfacing the PCG to the ETI-640 you might like to power the board up, with IC13 (the character generator ROM) still in the ETI-640, where it is known as IC4. Make sure that no large blue sparks, smoke or bad smells appear when you power up the board. Run the backs of your fingers over the ICs for a few seconds to ensure that nothing is getting too hot.

If you have an S100 bus system, simply plug in the PCG conveniently near the ETI-640. In this case it is assumed that all signals that are required to drive the PCG are on your bus. The signals that the PCG requires are very simple and you shouldn't exhibit any problems with the idiosyncrasies of the S100 bus.

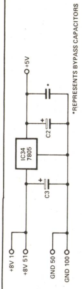
If you don't have an S100 bus system then you are in for another wrap/solder operation. The "spare socket" as marked on the overlay may be used for extra gates to derive some sort of S100 signals for the PCG. Since you already have an ETI-640 on your system you already have MWRT and MEMR signals. All you will have to generate is OUT and INP. Refer to the ETI September 1977 issue for more details on these signals. ▶



Overall circuit of the character generator

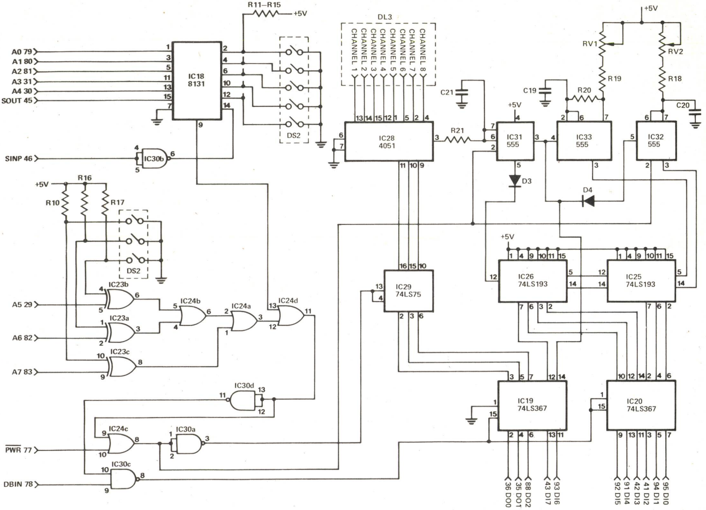


Logic probe circuit



*REPRESENTS BYPASS CAPACITORS

Supply regulation



Overall circuit of the joystick section

HOW IT WORKS — ETI 641

The functional description of the PCG board may be conveniently divided into three parts: the logic probe, the PCG, and the joysticks.

THE LOGIC PROBE:

IC1a and 1b drive the green (logic 0) and red (logic 1) LEDs respectively. Since both aren't on together only one dropping resistor, R1, is required. When the input, point 'A', is *low* IC1, pin 2 will go *high*, forcing the green LED on.

IC1d, 1e and 1f are wired as an oscillator running at a frequency of about 5 Hz. When point 'A' is open circuit, or connected to a tri-stated signal, the LEDs will flash at this rate, indicating a tri-state condition. Since point 'A' is being driven by this oscillator through R2, some signal distortion may occur, particularly when looking at open collector signals. If this is a problem R2 should be removed and tri-stated signals will appear as logic 1 (red LED).

PCG:

In normal running mode (no processor accesses), buffer ICs 21, 22 and 27 are turned off and selector ICs 11, 12 and 6 are driving RAM addresses with character and row information from the ETI-640 VDU via DIP lead DL2. R/W is forced high (read) and C5a inverts the most significant address so that either the lower 1K (ICs 15 and 17) or the upper 1K (ICs 14 and 16) is enabled.

Appropriate dot data is produced by both the RAM (ICs 14 to 17) and the ROM (IC13). IC9 and IC10 select whether data from the ROM or RAM is supplied back to the ETI-640. These selectors are switched by the state of the ROM/PCG RAM bit (IC8). The addresses for IC8 come from the ETI-640 via DIP lead DL1. The displaced 2102 chip becomes IC7 and still functions normally as the graphics/normal bit.

Input data (DO2) for IC8 is provided by IC19. R/W for IC8 is provided by the ETI-640. Output data is gated onto the bus by IC2 whenever a read from ETI-640 memory is made. Since this read condition cannot simply be detected by the PCG it is taken from the ETI-640 via point 'B'. The eighth bit from RAM is taken back to the ETI-640 via point 'D' because only seven bits are available on DL2.

IC3 compares A11 to A15 with the DS1 settings. IC3 pin 9 will go low when the processor is doing a read or write to the PCG memory. IC4a and IC4c turn on the RAM data input buffers (ICs 22 and 27) and the RAM data output buffers (ICs 21 and 22) respectively. During processor accesses incorrect character information will be given to the ETI-640. To prevent these 'flickers', Q1, via point 'C', blanks the ETI-640 screen.

Selector ICs 6, 11 and 12 supply processor addresses to the RAMs during accesses. IC5c and IC5d add 12 (decimal) to the processor address (without carry above A2) because the top row of each character has a row address of 12 (decimal) on the ETI-640. Refer to ETI April 1978 page 35 for an explanation.

JOYSTICKS:

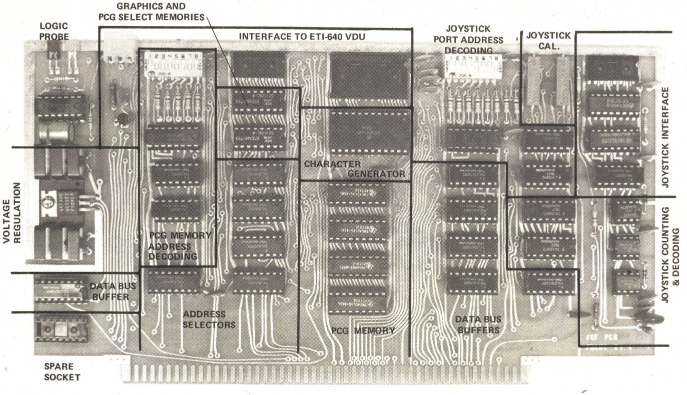
The joystick conversion sequence is triggered by a write to the joystick port. ICs 18, 23 and 24 detect a port access to the port address selected by DS1.

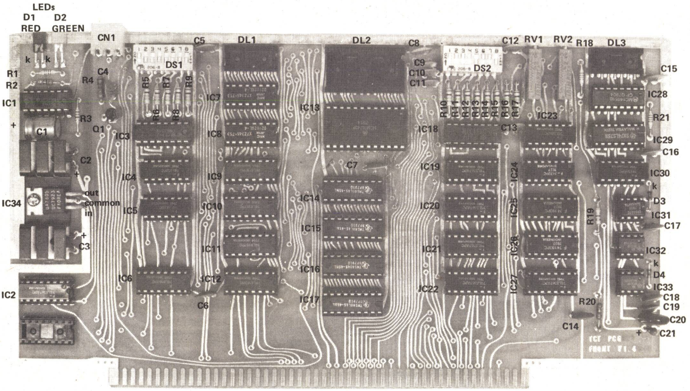
A write to the joystick port latches the lower three bits of the data bus (IC29). This is the channel number. The write also triggers ICs 31 and 32, both monostables. IC32 holds the counter ICs 25 and 26 cleared for a period set by RV2. The period of IC31 is proportional to the resistance selected by IC28.

After being held cleared for the duration of IC32, counter ICs 25 and 26 count the pulses from IC33 for the duration of IC31. If the count reaches 127 (decimal), the maximum value, the monostable is reset prematurely by D3.

The output of IC31 is the top bit of the joystick input port. When this is low the remaining seven bits represent the converted value of the input channel.

IC30c detects a read from the joystick port and turns on ICs 19 and 20 so that the outputs of ICs 25, 26 and 31 may be put onto the processor's input bus.


LOGIC PROBE
GRAPHICS AND PCG SELECT MEMORIES
INTERFACE TO ETI-640 VDU
JOYSTICK PORT ADDRESS DECODING
JOYSTICK CAL.
JOYSTICK INTERFACE
JOYSTICK COUNTING & DECODING
VOLTAGE REGULATION
CHARACTER GENERATOR
PCG MEMORY ADDRESS DECODING
DATA BUS BUFFER
ADDRESS SELECTORS
PCG MEMORY
DATA BUS BUFFERS
SPARE SOCKET


LEDs
D1 RED
D2 GREEN
CN1
C5
DL1
DL2
C8
C12
RV1
RV2
R18
DL3
k
k
R1
R2
C4
R4
DS1
C9
C10
C11
DS2
C15
IC1
R5
R7
R9
IC7
IC13
R10
R11
R12
R13
R14
R15
R16
R17
IC28
R6
R8
+
R3
C1
Q1
IC3
IC8
IC18
C13
IC23
R21
IC29
C16
C2
+
IC4
IC9
C7
IC19
IC24
IC30
k
D3
IC34
out
common
in
IC5
IC10
IC14
IC20
IC25
R19
IC31
C17
IC15
+
C3
IC11
IC21
IC26
IC32
k
D4
IC6
IC12
IC16
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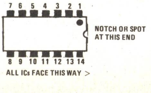
IC27
IC33
C18
C19
IC2
C6
IC17
R20
C20
C14
+
C21

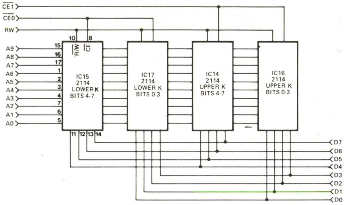

7 6 5 4 3 2 1
NOTCH OR SPOT AT THIS END
8 9 10 11 12 13 14
ALL ICs FACE THIS WAY >

PARTS LIST - ETI 681

Resistors	all ¼W, 5% unless noted
R1,R18-19,R21	330R
R2, R4, R20	1k
R3	1k9, 2%
R5 - R17	10k
RV1, RV2	5k multiturn trimpot
Capacitors	
C1, C2	10u tantalum, 6V
C3	100u electro
C4 - C18	22n ceramic
C19	1n ceramic
C20	82n ceramic
C21	see text
Semiconductors	
D1	red LED, TIL220 or sim.
D2	green LED, TIL222 or sim.
D3, D4	1N914
Q1	BC548
IC1	74LS514
IC2, IC27, and IC19-22	74LS367
IC3, IC18	8131
IC4, IC30	74LS00
IC5, IC23	74LS86
IC6, IC9-12	74LS157
IC7, IC8	2102, see text
IC13	MCM6574 or MCM6674, see text
IC14-IC17	2114
IC24	74LS32
IC25-IC26	74LS193
IC28	4051
IC29	74LS75
IC30	74LS00
IC31-IC33	555
IC34	7805 or LM340T-5
Miscellaneous	
pc board	ETI-681
DS1, DS2	8-way DIP switches
DL1	16-pin DIP-to-DIP lead
DL2	24-pin DIP-to-DIP lead with one inverted end
DL3	16-pin DIP-to-bare wire lead
CN1	3-pin pc mount plug-socket set

Two 24-pin IC sockets; four 18-pin IC sockets; 22 16-pin IC sockets; six 14-pin IC sockets; three 8-pin IC sockets; "flatpack" heatsink and mounting/insulating hardware for IC34.

NOTES: If you have an ETI-640 VDU board then IC7 and IC13 above will come from the ETI-640 board. The DIP switches are not socketed. Resistors R5 through R17 may vary one standard value either side of that given as these components are not critical — the same goes for C1, C2 and C4 through C18. All TTL ICs may be either normal TTL chips or TTL LS types, any mix of these types should function normally in this project. The value of C21 depends on the value of the joystick pots and the method of obtaining its value is given in the text.


CE1
CE0
RW
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
10
8
15
16
17
1
2
3
4
7
6
5
R/W
CE
IC15 2114 LOWER K BITS 4-7
IC17 2114 LOWER K BITS 0-3
IC14 2114 UPPER K BITS 4-7
IC16 2114 UPPER K BITS 0-3
11
12
13
14
D7
D6
D5
D4
D3
D2
D1
D0

The RAM array circuit — see also complete circuit on page 70.

Interfacing

The next major step is to interface the PCG to the ETI-640. This is done in three steps:

- Firstly, unplug the character generator MCM6574 or MCM6674 and the 2102 graphics select RAM from the ETI-640 and plug them into the PCG. Their ETI-640 chip numbers are IC4 and IC22, and their new PCG numbers are IC13 and IC7 respectively.
- Two DIP leads connect the ETI-640 to the PCG. One 16-pin DIP-to-DIP lead connects DL1 on the PCG to the position previously occupied by IC22 and one 24-pin DIP-to-DIP lead connects DL2 on the PCG to IC4 on the ETI-640. Note that the 24-pin DIP cable has pins pointing in one direction at one end and the other way at the other end. This isn't essential, but avoids the need to twist the cable, which could look messy. With the right angle bend in the 16-pin DIP lead and the strange or twisted 24-pin DIP lead, make extra sure that their orientations are correct, i.e: make sure that pin 1 of IC22 is connected to pin 1 of DL1 and not pin 9!
- Finally, three connections must be made through connector CN1. These wires connect points "B", "C" and "D" on the PCG to various points on the ETI-640. Connect these lines as follows:

a) Connect a wire between pad "B" and pin 8 of IC33 on the ETI-640.

b) Connect a wire between pad "C" and pin 12 of IC16 on the ETI-640.

c) i) Cut the pad between pins 14 and 15 of IC5 on the ETI-640, ensuring that the track going to these pads is still connected to pin 15.

ii) Connect a wire between pad "D" and pin 14 of IC5 on the ETI-640.

The PCG is now (hopefully) correctly interfaced to the ETI-640.

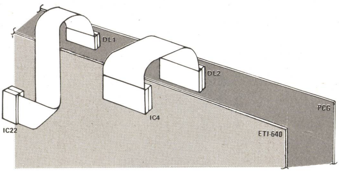
Setting up

Having completed all the work associated with "construction" and "interface", there is more to come! (Sorry to disappoint you.) The next thing to do could be broadly defined as "setting up" the PCG. This involves setting the DIP switches, setting up the joystick circuitry and testing the PCG.

DIP switch No. 1:

DIP switch 1, or DS1 has two functions: these are to locate the PCG's 2K of memory at any 2K boundary in your microcomputer's address space and to turn the logic probe on and off.

DS1 is functionally illustrated in Figure 2. Locating PCG memory using ▶



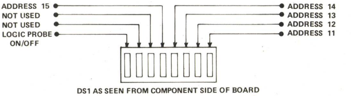


Figure 2. Functional arrangement of the DIP switch DS1.

LEFT: Linking the ETI-681 to the ETI-640 VDU.

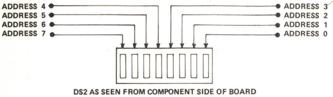


Figure 3. **Functional arrangement of the DIP switch DS2.**

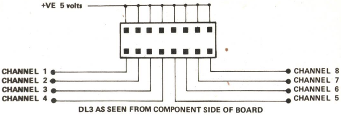


Figure 4. **How the joystick pots connect to DL3.**

DS1 is much the same as locating the ETI-640's memory. To locate the board at a certain address simply set that address on the DIP switch, remembering that a closed switch represents a "0" for that address. For example, to locate the PCG at hex 'E800' set the address switches to off, off, off, on and off.

For software compatability we recommend that you put your PCG at 'F800' if your ETI-640 is at 'F000', or at '7000' if your ETI-640 is at '7800'. If your ETI-640 is at neither of these locations then choose any convenient address and enjoy converting software so that it will run in your system! The operation of the on/off switch for the logic probe is obvious.

DIP switch No. 2:

This DIP switch is used to locate the I/0 port that the joysticks use. It is functionally shown in Figure 3 and operates in a similar fashion to DS1.

DS2 can locate the joystick port to one of 256 possible I/0 ports (0 to 'FF' in hex). We recommend that you put the joystick port at hex 'FF', for no particular reason other than that we don't know of anyone's I/0 that will conflict with this port.

If too many people are already using this port, strongly object and we will try to move it.

Testing the PCG:

Well, now comes that big moment. Although you know that nothing explodes when you power up, you don't know whether it works. There is only one way to find out — plug your system back together and power up. You should be confronted with a screen absolutely full of garbage!

You should have flashing, graphics, normal and random PCG characters all appearing.

Firstly, clear the screen using your system monitor and set the top line of the screen to non-scrolling if you have a scrolling monitor. Then do the following:

1) At 'F800' store hex 80, 40, 20, 10, 08, 04, 02, 01, 01, 02, 04, 08, 10, 20, 40, 80.
2) At 'F000' store '0'.
3) At 'F400' store '04'.

In the top left hand corner of your screen you should see an extended "greater than" sign.

The joysticks:

Up to eight pots may be connected to the joystick circuit, each connected to an input channel. These channels are found on DL3, and the layout of DL3 is shown in Figure 4.

To connect a pot to a given channel simply connect the pot wiper to one end of the carbon track and also to +5 volts. Connect the other end of the pot to a channel input.

While we could simply tell you how to set up the joysticks we feel that it would be better if you had some understanding of what you are really setting up.

As the resistance of the joystick varies, the converted value will vary between 0 (minimum resistance) and hex '7F' (maximum resitance). Figure 5 is an attempt to show what the joystick circuit produces as a converted value. Period 1 is the time for which the count stays at a value of 0 and is typically 0.1ms. Period 2 is the time for which the count increments to a value of hex '7F'. Period 3 is where the count stays at hex '7F'. This whole counting sequence is stopped after Period 4 which is proportional to the resistance of the selected pot. Thus, as the joystick is moved from minimum resistance there will be a band for which the count will be 0 (set by RV2), a band in which the count will count up to 127 (hex '7F'), set by RV1, and a band for which the count will be 127 as the joystick is moved to maximum resistance.

The method for setting up the joysticks is outlined below, and simply involves setting RV1 and RV2.

1) Firstly connect a pot, or half a joystick, to channel 1 on DL3.
2) Write a program to
   a) write a '0' to port 'EF' hex (or your joystick port).
   b) read port 'EF' until bit 7 (MSB) is low.
   c) display the remaining 7 bits on the ETI-640 in hex.

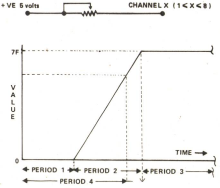


Figure 5. **Illustrating the relationship between the joystick 'value' and the counting/timing sequences.**

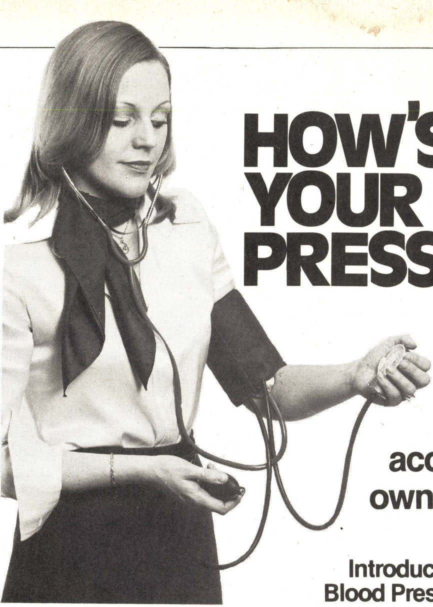
   d) jump back to a).
3) Run the program.
4) Set the pot to a position for which you want band 1 to last.
5) Set RV2 until the reading on the screen is just 00.
6) Set the pot to a position for which you want band 2 to last.
7) Set RV1 until the reading is just '7F' hex.

The setting of the joystick circuit is now complete. Stretch band 1 and compress band 2 a little if you cannot get the full count range (0 to 127) for each joystick that you connect.

If you try to read the value of an unconnected channel the conversion sequence will never be completed. If your processor locks up while using the joysticks this is a possible reason. While we were designing the PCG we decided not to do anything about this illegal condition since it shouldn't occur anyhow, and if it does it is a good indication that something is amiss.

When Dave Griffiths designed the ETI-640 he made life easier for himself making the VDU clock out nine bits for each character. The ninth bit takes on the same value as the eighth bit.

In fact, we didn't even notice this ourselves; it wasn't until someone fired up the PCG with a good monitor and began drawing diagonal lines on the screen that the problem was noticed! You shouldn't be unduly concerned with this problem; in fact, we doubt that many of you would have noticed it if we didn't mention it.! ●



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Please note: This offer is made by the Caldor Corporation, 12 Terra Cotta Drive, Blackburn, Vic., 3130. This magazine is acting as a clearing house for orders only. Cheques should be made out to 'Caldor Offer' and sent together with order to 'Caldor Offer', Electronics Today Int., 15 Boundary Street, Rushcutters Bay, NSW, 2011. ETI will process orders and pass them on to Caldor who will then send out the units by certified mail. Please allow approximately four weeks for delivery.

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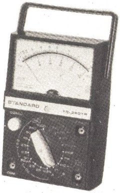

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DC Current: 0-0.06, 3, 30, 300mA, 12A.
Ohms: 0.20 Megohms in 4 Ranges ±3%, 20 ohms centre Scale. Decibels: -10 to +17.
Transistor checker: Iceo (L1)
0-150μ A on x 1K Range.
0-15mA on x 10Ω Range.
0-150mA on x 1Ω Range.
hfe 0-1000 on x 10Ω Range. IC/IB
Accuracy: DC, ±3% full scale; AC. ±4% full scale; Resistance. ±3% of scale length.
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DC Current: 0-0.05, 2.5, 25, 250mA
Ohms: 0-20 Megohms in 4 Ranges ±3%, 20 ohms center Scale.
Decibels: -10 To +22
Transistor checker: Iceo(LI)
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Accuracy: DC ±3% full Scale. AC ± 4% full scale.
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Size: 106mm x 149mm x 55mm
Weight: 580g

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DC Current: 0-0.25, 25, 500mA
Ohms: 0-1 Megohms in 3 Range 10 ohms center Scale.
Decibels: -20 To +22
UF: 0.0001 ~ 0.02μF 0.01 ~ 0.3μF
Accuracy: DC ± 3% AC ± 4% ohms ± 3%
Battery: UM-3 1.5V x 1
Size: 95mm x 140mm x 45mm
Weight: 310g

ST-5 A mini tester, 4K ohm/V DC & dB range, provides satisfactory performance.

SPECIFICATIONS:

DC Voltage: 0-5, 25, 250, 500 Volts 4K /V.
AC Voltage: 0-10, 50, 500, 1,000 Volts 2K /V.
DC Current: 0-250μA, 250mA.
Ohms: 0.600K
Decibels: -10 To +22
Accuracy: DC ± 3% AC ± 4% ohms ± 4%
Battery: UM-3 1.5V x 1
Size and: 60 x 90 x 34mm
Weight: 110g

ST-300. This CLAMPTESTER has fuse protection, shock proof movement & comes complete with Test Leads & carrying case.

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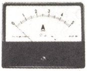
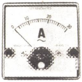
Resistance: 0-1,000 ohms
Accuracy
AC Current: ±3% of full scale
AC Voltage: ±3% of full scale
Resistance: ±3% of linear scale
Battery UM-3 1.5 Volts X 1
Dimentions 196mm X 86mm X 46mm
Weight 370g
Accessories
Test Leads
Carrying Case.



ST-100



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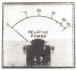
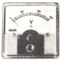
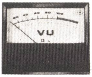


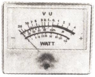
ST-660



ST-45



ST-680



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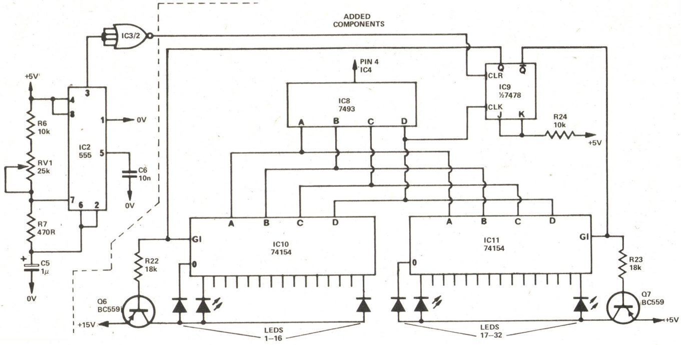
Ideas for Experimenters

These pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory. Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we produce constructional details.



NOTE
THESE COMPONENTS FROM ORIGINAL DESIGN ARE NOT USED

IC5,7
Q2–5
C9,C10
R11,13,15–21
DISP 1

GND IC10,11 PIN 12
GND IC8 PIN 11
GND IC7 PIN 7

+Ve IC10,11 PIN 24
+Ve IC8 PIN 4
+Ve IC9 PIN 14

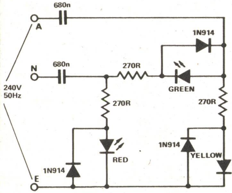
Analogue readout for ETI-318 digital tacho

Here is a modification to the ETI-318 digital car tacho to produce an analogue readout in a bar or ring display of LEDs.

The LEDs each represent 200 rpm, when the unit is calibrated properly, which gives a range of 0-6200 rpm, sufficient for most cars.

The prototype had the LEDs mounted in a ring surrounding a digital clock and the LEDs were green from 0-4800 rpm and red above 5000 rpm. This gave a clear indication when the engine was being over-revved. Another fine idea from **D.L. Shaw of North Ryde, NSW.**

* * *



NOTE
BOTH CAPACITORS MUST BE GREATER THAN 350V DC WORKING

Simple LED mains tester

This simple little circuit from **D.L. Shaw of North Ryde NSW**, will help you find out if your power wiring is ok. The circuit indicates the following wiring conditions:

Normal ... green and yellow LEDs lit
Active and Neutral Interchanged .... red and yellow LEDs lit
Earth open-circuit ..... all LEDs lit
Neutral open-circuit .... all LEDs lit
Active open-circuit .... none of LEDs lit

Note that when Active and Neutral are interchanged the red LED will be lit even when the power switch is off. Both 680n capacitors should be rated at 350 Vdc working or greater — 630 V polystyrene or 1kV polyester capacitors would be prefered.

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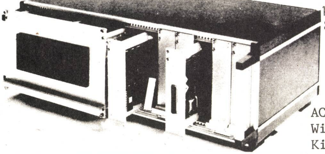

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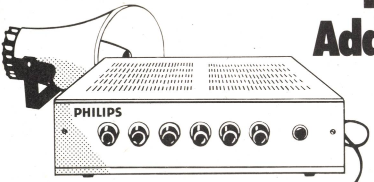

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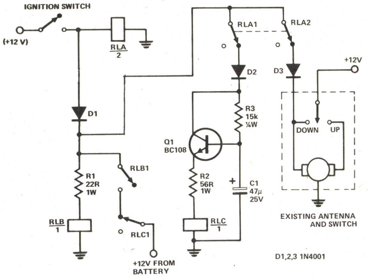
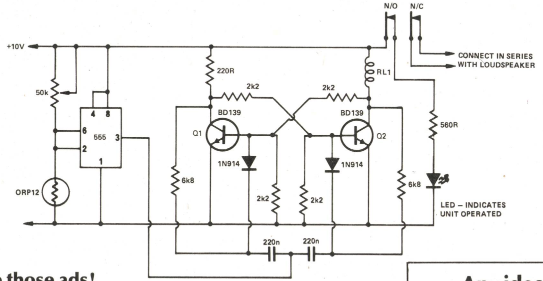
Ideas for Experimenters

Automatic antenna retract

This circuit was designed to retract automatically a motorised car antenna every time the ingnition is turned off. With ignition on, relays A and B are energised (total current drain about 100 mA). When the ignition is turned off, relay A is turned off and 12V from the battery drives the antenna down and charges C1 via R3. With the values shown for C1 and R3, after about a three second delay relay C is energised and interrupts power to relay B, removing supply voltage from the circuit. This circuit suits the two-wire control motorised antennas commonly available and comes from **Ian Hawke of North Richmond, NSW.** The values of R2 and R3 may need to be adjusted to suit different motors as the retraction time varies.





Silence those ads!

This circuit, from **G.B. Wolfe of Bombala NSW**, will switch off the sound from a TV when those annoying adverts come on just as the programme is getting interesting. All you need is a torch handy in order to flash a light at an LDR.

The circuit operates as follows: when light is incident on the photodiode its resistance drops, driving pins 6/2 of the 555 towards 0V. This produces a positive-going pulse from pin 3 which is passed to the collectors of Q1 and Q2. Suppose the flip-flop is set with Q1 on, Q2 off when power is switched on. The positive pulse on the collector of Q2 has no effect but the positive pulse on Q1 collector is passed on to the base of Q2 via the 2k2 resistor and Q2 begins to switch on. The collector voltage of Q2 now begins to fall rapidly and this drives base of Q1 towards 0V, switching the transistor off. The circuit thus rapidly changes state to Q1 off, Q2 on. When Q2 is on, the relay operates, the loudspeaker is disconnected and the LED goes on.

A further flash of the torch on the photodiode will cause a pulse from the 555 and the flip-flop switches back to Q1 on, Q2 off. The loudspeaker is reconnected and "Cop-Shop" comes back into your living room!

Any ideas?

Have you had a bright idea lately, or discovered an interesting circuit modification? We are always looking for items for these pages so naturally, we'd like to hear from you.

We pay between $5 and $10 per item — depending on how much work we have to do on it before we publish it.

The sort of items we are seeking, and the ones which other readers would like to see, are novel applications of existing devices, new ways of tackling old problems, hints and tips.

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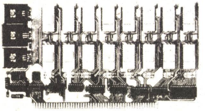

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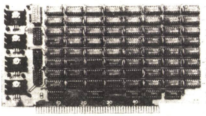

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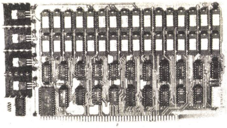

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7. Kit includes ALL parts and sockets.
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9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA **$45**
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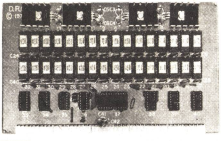

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FULLY STATIC AT DYNAMIC PRICES

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5. All Parts and Sockets included
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BLANK PC BOARD— **$39** COMPLETE SOCKET SET— **$15**
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ITOH Model 8300 PRINTER. $770 plus 15% sales tax.

This 80-column printer provides quiet operation, making it suitable for use in offices, classrooms and homes. Specifications include 125 cps, 60 lines per minute, paper loading from bottom or rear and Centronics-compatible, parallel interface.

A bidirectional, dot matrix impact printer with a print head designed for 100 percent duty operation, assuring a print life that exceeds 100 million characters. The precision sprocket-feed mechanism permits printing forms from 4½ to 9½ inches wide. A 96 ASCII character set prints in upper and lowercase with the added capability of producing double-width fonts in boldface. The vertical format unit provides preprogrammed/ programmable tab positions, top of form and bottom of form for complete formatting capabilities.

RITRON 8 SLOT MOTHERBOARD: KIT $65.90 inc. tax.
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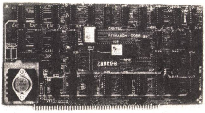
RITRON COMPUTER GRADE POWER SUPPLY: +5V Reg, 10A, ±16V Unreg. Kit of parts $79.95 inc. tax. A&T $99.95 inc. tax.

Write for list of other power supplies. Tax free prices also available.

S-100 Z80 CPU CARD

Perfect for OEM's



$189.00
Wired & Tested

4 MHZ

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FEATURES:
★ 2 or 4 MHZ Operation. ★ Generates MWRITE, so no front panel required.
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★ Top Quality PCB. Silk Screened. Solder Masked. Gold Plated Contact Fingers

JUST WRAP KIT - JWK-6 $39.50

● 50ft ea. blue, white, red, yellow wire ● Just Wrap Tool ● Unwrap Tool

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Prices current till 7th June, 1980. Heavier items add additional postage. Extra heavy items sent Comet freight on. Prices subject to change without notice. Send 60c and SAE for free catalogues. MAIL ORDERS: PO Box 135, Northcote, Vic 3070. Minimum pack and post $1.00. Phone (03) 489 8131.

Shoparound

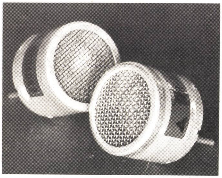
Pre-Pak Electronics, alias "Mad Mal", recently moved from the old Parramatta Rd, Croydon, address to new premises located at 1A, West St, Lewisham. Patriotically tricked out in red, white and blue, the shop is just off Parramatta Rd, at the bottom of Taverners Hill. Plenty of bus routes run along Parramatta Rd, plus Lewisham station is only two short blocks away. Mad Mal has a host of opening specials, so if you're after bargains, check them out now — and he's open seven days a week. Mal's mail order man still lives in P.O. Box 43 at the Croydon Post Office, 2132. Phone No. is 569-9797.

First up, with regard to last month's feature project, the **ETI-456 140W Valve Amplifier**, we have had a number of enquiries about sources for the "Multimesh" expanded metal used for the top cover. Multimesh is a trade name for a variety of expanded metal products manufactured in Australia by Lysaght Brownbuilt Industries.

It is available in steel or aluminium; steel Multimesh comes in four styles, aluminium in six. We actually used "Lace" style steel for the top cover on our prototype valve amp. Multimesh can be purchased from various hardware stores — we bought ours from Nock & Kirby in Sydney, it cost about $3 for a 1200 x 900 mm sheet. It is also available in 600 x 900 mm sheets. A handy brochure is available with the product, showing how to cut and form it.

The **Series 4000/2 Three-Way Speaker System** will undoubtedly prove popular among the average do-it-yourself hi-fi enthusiasts. As with the Series 4000/1 Four-Way System, complete kits, including all drivers, boxes and crossover components, will be sold through Philips retail dealer outlets right around Australia. Suppliers currently stocking the four-way system would welcome enquiries about the 4000/2 three-way project. For a list of suppliers, refer to the Philips advertisement on page 125 of the April 1980 issue. Philips distributors in Queensland, South Australia, West Australia and Victoria will be happy to advise you of your nearest dealer.

The **Simple NiCad Charger, ETI-578,** should present few difficulties to constructors seeking components. The Ferguson PL24/20VA low profile transformer is an item widely stocked by suppliers. However, any transformer that has two 12 V secondaries rated to deliver 700 mA or more will do just as well — you might have to choose your case to suit the transformer though. Printed circuit boards will be available through most of the suppliers listed on our 'Kits for Projects' page (160 this month), while Scotchcal front panels may be obtained from Radio Despatch Service in Sydney or Rod Irving Electronics in Melbourne.



If the "Experimenting with ultrasonics" article in this issue has you hot to trot, then you'll likely want to know who we could find that stocked the appropriate transducers. We managed to find three firms, but there may be more, so phone your favourite supplier anyway. All Electronic Components and Magraths, in Melbourne, stock 40 kHz types as do Dick Smith stores all over. Phone first to see if they have stocks on hand. Prices range from a low $4.50/pair up to about $7 per unit (transmitter or receiver). All Electronic Components may be able to supply 25 kHz types also.

The **ETI-681 Programmable Character Generator** developed by Craig Barrett is in the same category as previous S100 computer projects we have published — the ETI-640 VDU, the ETI-680 CPU and the ETI-643 EPROM programmer; copyright on the pc board has been retained by the designer. Craig Barrett has arranged for pc boards to be made available through Applied Technology, both retail and trade. Complete kits, with all ICs, cables and an instruction manual, will also be available through Applied Technology. Trade enquiries to Len Hensen at Applied Technology.

For the — as we have said before — hardy, adventurous soul willing to tackle the manufacture of the double-sided pc board, copies of the artwork can be obtained by sending a *large* SAE to:

PCG PCB ETI-681
ETI, 4th Floor, 15 Boundary St
Rushcutters Bay 2011 NSW

Remember, however, that you can only obtain the artwork solely for your own use as a private individual.

There should not be too much difficulty encountered in obtaining the ICs. However, if you're contemplating the project it would be prudent to buy now as it is strongly rumoured that there will be a shortage of digital chips next year, or even earlier.

Price estimates

Once again, we would like to stress that *these are estimated prices only.* We publish this information as a guide only, all costing is done using generally the highest retail prices we can find. However, price movements and other factors may affect the overall cost of a project or kits offered.

ETI-497 3-way speaker	$350-$450 (depending on with/without boxes)
ETI-578 NiCad Charger	$28-$35
ETI-681 Prog. Character Generator	$150-$175

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POSTAL: PO Box K21, Haymarket, NSW 2000. Cable: Emtron Sydney.

MICROBITS

COMPUTER TRANSFORMERS.

9 V @ 3A	2 x 15V @ 0.5a	$12.50
9 V @ 10A	2 x 15V @ 1A	$32.00
9 V @ 10A	9V @ 1A 2x15V @ 1A	$38.00

The latter being the professional version with better egulation and a larger stack to take a bit of overload.

OTHER TRANSFORMERS AVAILABLE EX STOCK:

5VA :-	9v ct, 12v ct, 15v ct, 18v ct, 24v ct, 30v ct, 40v ct.	$4.60
20VA:-	12v ct, 15v ct, 18v ct, 24v ct, 30v ct, 40v ct.	$7.65
40VA:-	15v ct, 18v ct, 24v ct, 30v ct, 40v ct, 9.30v ct.	$8.50
60VA:-	12v, 15v, 24v ct, 30v ct, 40v ct.	$10.90

Centre tap transformers are actually two separate secondaries hich can either be seriesed or paralleled to give voltage shown above or half that voltage. To determine current divide VA by V.

BRIDGE RECTIFIERS TO SUIT ABOVE. MDA3500 $4.60

5VA transformers are P.B.C. mount the rest have flying leads.

CAPACITORS (Computer grade)
2200MFD 15V $5.7430000MFD 25V $10.47

Regulators:
5V 5A $4.87 5V 10A $7.48
5A adj. $9.50
3 term. +ve 1A - 5, 8, 12, 15, 18, 24V — $1.17
3 term. −ve 1A — $1.50

BATTERIES: 6V 4AH $11.00
6V 5AH (flat-pack) $15.00

EDGE CONNECTORS
(85 PIN) $10.40 P.C.B. or wire lug.

CALCULATORS
TEXAS INSTRUMENTS. TI Programmer $63.00, TI55 $63.00, TI30 $18.00. All prices listed ex tax. Student discounts available.

PRINTERS
MODEL 8300

Print Speed:	125 CPS
Char. Font:	7x5 dot mat.
Columns:	80 column
Char. Spacing:	10 cpi
Line Spacing:	6 lpi
Paper Width:	4.5 to 9.5 in

MODEL 1540
125 cps
9x7 dot mat.
136 column
5/10 cpi
6 lpi
Max. 15.5 in.
Interface: 8 bit parallel (standard), RS232C/TTY (opt).
No. of copies: Original plus 3 nominal (max 0.28mm)
Enlarged characters software controlled.

Mod 8300	$ 840.00 + $100.00 tax
Mod 1540	$1120.00 + $125.00 tax

CANNON CONNECTORS:

	Male	Fem.	Chass.Male	Ch.Fe.
3 PIN	$4.10	$4.30	$2.80	$4.40
4 PIN	$4.10	$6.10	$2.80	$4.40
5PIN	$5.30	$8.10	$3.25	$6.25
240V Line	$4.90	$5.50	$4.10	$4.90

CANNON PRICES INCLUDE TAX

EVER HAD TROUBLE CONNECTING YOUR COMPUTER TO THE REAL WORLD?
Our 2111C-A Controller lets you connect to a.c. supplies from 12v to 240v and control on-off or variable 0 to Max volts.
The 2111C-A is plug in, connects direct to opto couplers, 0-10v or Potentiometer and can control loads from resistive to heavy inductive (transformers etc.). The standard nit delivers 1A and up to 5A with heatsink attached. (For loads up to 40A the triac has to be mounted off board.) On board pots limit minimum and maximum voltages to the desired level. Built and tested. $28.00 Professional Ver. $35.00 Edge connector P.C.B., Transformer, opto to suit 2111C-A $7.50.
Base Board takes 4 units. Built and tested $32.00.

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TELEPHONE 89 3145. Quantity discounts avail. ADD 15% sales tax where applic. FREIGHT FORWARD ON ALL ITEMS.

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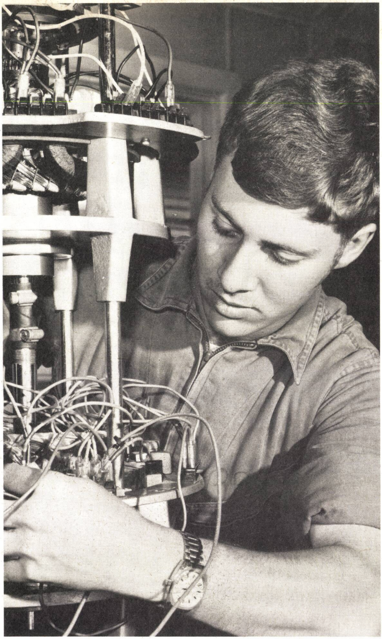
Opportunities for young men (15-17*) in the Electronics and Electrical Trades.



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- Electrical Mechanics in the field of high and low voltage electrical generation, reticulation and distribution systems.
- Electrical Fitters in the fields of electronic devices, electrical control equipment and domestic electrical systems.

The 9 years enlistment period will include a 4 years apprenticeship at the Army Apprentice School at Balcombe in Victoria and in Army technical units (leading to civilian trade qualifications) and 5 years further training in the Army corps of Signals, Electrical and Mechanical Engineers or Engineers as appropriate.

Enquiries are being accepted from prospective applicants who are successfully studying at Year 10 or 11 School level. They will be required to present documentary evidence of successful results of their previous completed School year at formal application.

It is important to understand that the number of applications that can be accepted is very limited. If you're interested, don't wait or you will miss out. Fill in this coupon or phone an Army Apprenticeship Counsellor.

Brisbane 226 2626; Townsville 71 6784; Sydney 212 1011; Newcastle 2 5476 or 2 4728; Wollongong 28 6492; Canberra 82 2333; Melbourne 61 3731; Adelaide 223 2891; Perth 325 6222; Hobart 34 7077.

**Applicants must be at least 15 years old but still under 17 years old on entry. If you are over 17 years you may apply to join the Army Adult Tradesman Scheme as an Electronic Tradesman trainee.*

Authorised by the Director General of Recruiting, Dept. of Defence.

For further information, post this coupon.

To: Army Apprenticeship Adviser, G.P.O. Box XYZ

(insert name of your nearest capital city and postcode)

Please send me details of ☐ Army Electronic and Electrical Trades Apprenticeships ☐ Adult Electronic Tradesman Trainee.

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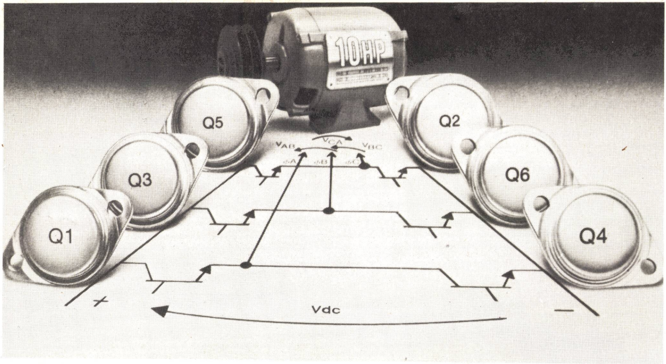

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			NPN		PNP		
Ic	Vceo	hfe min @ Ic	Part No.	Price 100+	Part No.	Price 100+	Case
0.5	300	30 50MA	MJE340	0.67	MJE350	0.94	Case 77
4	45	10 4 Amp	2N6121	0.38	2N6124	0.40	To.220
4	80	10 4 Amp	2N6123	0.42	2N6126	0.44	To.220
4	300	10 1 Amp	MJE13004	1.35			To.220
4	400	10 1 Amp	MJE13005	1.70			To.220
8	400	12 2.5 Amp	2N6545	2.02			To.3
8	100	1000 3 Amp	MJE6045	1.49	MJE6042	1.77	Case 90
8	150	40 2 Amp	MJE15030	1.36	MJE15031	1.36	To.220
10	600	20 5 Amp	MJ10014	7.30			To.3
10	60	25 3 Amp	MJE2801	1.09	MJE2901	1.60	Case 90
10	60	20 4 Amp	MJE3055	0.54	MJE2955	0.54	Case 90
15	60	20 4 Amp	2N3055	0.52	MJ2955	0.65	To.3
15	400	300 3 Amp	MJ10012	2.84			To.3
15	400	12 5 Amp	2N6547	4.56			To.3
16	100	1000 10 Amp	MJ4035	4.08	MJ4032	4.72	To.3
20	140	25 5 Amp	MJ15003	2.50	MJ15004	2.50	To.3
30	100	25 7.5 Amp	MJ802	2.19	MJ4502	2.19	To.3
50	400	25 20 Amp	MJ10015	13.86			To.3

It's rough shelling out $20 to $30 for 30-50 A power transistors that can turn the most practical design into a cost-overrun nightmare.

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LETTERS

Dear Sir

Amidst the published euphoria over your ETI-470 amplifier module. I wish to inject a dissenting voice. Adelaide appears to be a bad scene for the 470 with adverse comments appearing in several areas. At last, and at some extra cost, I have a module operating successfully, however my complaint centres on RV1. It appears that for most amps the trimmer is set for maximum resistance in the initial stage, but this on the 470 causes transistors to 'pop' like nobody's business. I suggest the following powering-up procedure.

1. Insert F1 and F2.
2. Set RV1 to a central position (near 12 o'clock).
3. Power-on, and off after 5 seconds. If any problem exists at least the Darlingtons will escape damage (in my experience!).
4. Replace F1 and F2 with 100 ohm resistors and adjust RV1 for 2.5V across them. (If resistors are inserted first and a fault exists, one buys another set of Darlington's — in my experience!).

On a more euphoric note my ETI-471 is a beauty except for two small points:

1. Doesn't SWA insert a 'passive' loudness system which 'cuts' the mid-range rather than 'boosting' the extremes?
2. The Hi-Cut filter 'thumps' when switched in — may be peculiar to mine.

Apart from those points I thank you for that design.

Looking forward to your comments to help us 'home builders'.

Bryan Wetton
Blackwood, S.A.

Many thanks for your comments concerning our very popular 60W low distortion amplifier module, the ETI-470, published in the May 1979 issue.

In retrospect, we should have included a warning in the construction article to the effect that **the power supply should not be connected for a quick test prior to setting the bias current.** *In their eagerness to 'fire up', it seems a number of constructors have come to grief through doing this, according to our assessment of phone and letter enquiries.*

The moral is: 'slowly, slowly catchee monkey'.

Your procedure is unsafe. If you have a fault, at first turn-on it is possible to destroy the output devices, regardless of where you set RV1. If 100 ohm resistors are inserted in place of the fuses, these will be destroyed in the event of a fault.

The absolute safest way to proceed is as follows:

- *Obtain, buy, beg, borrow or steal a Variac (240 Vac variable auto-transformer).*
- *Connect up nothing at this stage.*
- *Insert 100 ohm resistors in place of F1 and F2.*
- *Set the wiper of RV1 to the end connected to R11 (i.e: away from the heatsink).*
- *Connect power supply ac input to Variac and set the latter to 0V output. Connect the power supply dc output to the 470 module (don't forget the 0V, or common , connection to the CT of the transformer secondary).*
- *With your trusty multimeter connected across one of the 100 ohm resistors aforementioned, turn on the mains switch and slowly wind up the Variac while observing the multimeter.*
- *The multimeter reading should rise to about 1V or thereabouts.*
- *Adjust RV1 for a 2.5V reading on the multimeter. Check that the same is obtained across the other 100 ohm resistor.*

If you don't have, or cannot get, a Variac, proceed as outlined in the article, **but first set RV1's wiper to the end nearest R11.**

Unless you have the output devices swapped over — and their positions can be clearly seen in the photograph on p.48 of that issue, plus they're clearly marked on the component overlay — then transistor will not "pop like nobody's business".

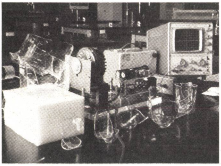
Going to the second part of your letter, concerning the ETI-471 (June 1979 issue), yes, SWA does insert a passive loudness control that puts a dip in the mid-range and rolls off the bass and treble. This filter has an overall loss, apart from 'contouring' the frequency response, so it's a matter of semantics whether you talk about boosting the bass and treble or cutting the mid-range.

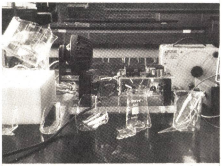
It is unclear why your hi-cut switch should 'thump' when turned on. If this occurs when the low-cut filter is switched out (C10 shorted), then I would suspect C9 may be leaky. Try changing C9 in any case. Alternatively, C15 may be leaky.

Despite the difficulties you experienced, we're happy you're otherwise pleased with the design. We hope the comments prove helpful.

Roger Harrison (Editor).

THE ETI-470 – A SMASHING PROJECT !





Greetings ETI,

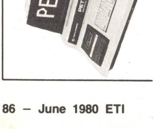
Recognize the ETI-470 60W amp module in the accompanying photographs? With the amp's input driven by an audio signal generator and the output driving a Toa model TU-50W throat-coupled speaker, the set-up has a devestating effect on two-litre beakers at 1442 Hz (+/− 0.1 Hz) at a range of several hundred millimetres!

This is without doubt the most dramatic demonstration of sympathetic vibration I have ever built.

The original idea came from an article entitled "Demonstrating Resonance by Shattering Glass With Sound", by W.C. Walker in the May 1977 issue of The Physics Teacher.

Now, with the ETI-466 300W amplifier module and a suitable driver — I wonder what is the fundamental mode for sympathetic vibration of plate glass windows? . . .

Kris McLean, VK2AJS
Granville Technical College, NSW

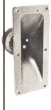


Space Invaders have arrived, get the game of the century. It's free with every 8K PET sold this month, along with a package of other programs and a book on programming. Super Special $999 complete.

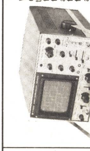
The Commodore Pet is a completely self-contained personal computer. Just plug in, and within a few short hours even the complete novice will be amazed at what can be done. The 8K model shown, 16K & 32K models are now available. Options available are External Cassette Decks, Dual Drive Intelligent Mini-Floppies and Printers. The 8K, 16K & 32K models are expandable up to 40K of RAM via plug-in memory boards.

Trendcom Printers. We now have available these high performance thermal printers. These print the full set of alpha-numeric characters at a rate of 40 characters per second. The Trendcom 100 is a 40 character-per-line printer, and the Trendcom 200 is an 80 character per line printer which also prints graphics.

Analog to Digital Conversion System. We will soon be offering a 16 channel analog to digital conversion system to enable your PET (interfaces for other computers will be available later) to sense temp, velocity, pressure, light level, fluid level, etc. — just think of the possibilities.



We handle a wide range of speaker components including RCF, Plessey-Foster and Motorola. Two of the Motorola Piezo-Ceramic tweeters are the KSN1001, which will handle 100W, with a response from 4K to 30 KHz, and KSN1025 which will handle 150W with a 2K to 30KHz response. These tweeters feature excellent transient response, low distortion, high impedance, high reliability and light weight. The KSN1001 is only $11.00 and the KSN1025 is only $21.00 (no cross-over is required).

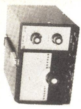


We handle the complete range of TRIO test equipment. The CS-1572 is a 30MHz dual trace oscilliscope. This CRO is ideally suited for use in all aspects of the T.V. industry and features a "video delayed trigger". This enables delayed sweep action to be started from any desired point in any single video frame. This CRO has a 5mV/div sensitivity and sweep time of 0.2 uS to 0.5 S/div. All this for only $1095.00. Probes to suit (PC-28) $47.70 each.

SPECIAL

CS-1560AII — $620.00

Or complete with probes $700.00.



TRIO SG-402 R.F.
OSCILLATOR —
100kHz-30MHz — $111

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APOLOGY — U.8 Cursor Control was incorrectly advertised at $5.95. It should have been $9.95. We are sorry for any inconvenience caused by this error.

Notes — All tapes have two copies of the program, one on each side. Printed listing is also included. 'Tone' and 'Volume' controls may need adjusting. Both FULL 'SAVE' and 'LOAD' is usually best.

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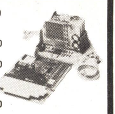

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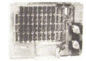

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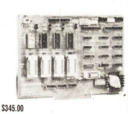

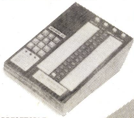

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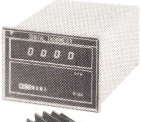

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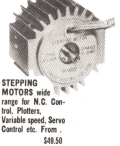

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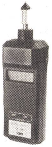

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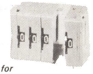

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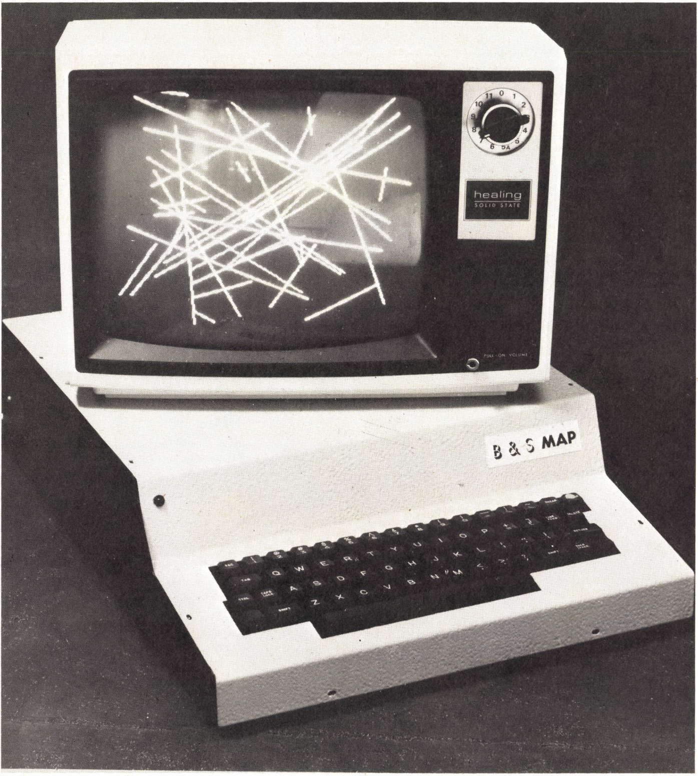
Review of the B & S



'Mini-Map' computer

Jonathan Scott

Locally designed and manufactured, the Mini-Map is an inexpensive machine targeted for school and classroom use.

WE RECENTLY had an opportunity to review a B&S MINI-MAP microcomputer system. Not only is this new entry to the microcomputer scene a comprehensive, ergonomic and practical package, as this article will show, but it is also entirely designed and built in Australia. The microcomputer has been accepted by the Education Department for use in schools and this means that there will be a sizeable number of the units around, which tends to ensure both good parts and hardware service, as well as software availability.

Features

The unit we tried out came with 16K of RAM, a card reader, a thermal printer, an input box and an output or relay box, the latter four items being housed in locally made outboard plastic boxes, and hence detachable from the main device. The main unit contains the keyboard and a number of connectors on the rear, which permits the connection of peripherals such as VDU, RS232 interface and domestic cassette player. The CPU is based on the 2650 microprocessor and our unit came with the 'BASIC' ROM option. This provides 8K of ROM containing an Altair type BASIC, including the graphics commands, the operating system and a rudimentary monitor allowing the usual range of commands but with no break-point facility. The other option has 6K of ROM which gives assembler, comprehensive text editor and monitor/operating system. There are eight non-standard commands which are briefly discussed here in order to give an idea of how the system feels. These are: **TONE, MODE, PNT** (for 'point'), **CLR, TOP, LINE, IN,** and **PR.**

TONE (P,D) —	where 'P' is the period of the waveform of a tone to be generated, and 'D' is the duration. (Uses a small speaker inside the case)
MODE (A,B) —	where 'A' defines the screen usage as defined below: 0 — screen filled with text 1 — top half text, bottom half 64 x 256 graphics 2 — top half text, bottom half 128 x 256 graphics 3 — a superimposition of the above, achieved by interleaving the lines 4 — full screen graphics, text invisible 5 — full screen graphics, 256 x 256

and where 'B' defines the character from, black-on-white, white-on-black, cursor blinking, etc.

PNT (0 or 1,X,Y) —	which sets to white or clears to black the point whose co-ordinates are given.
CLR —	which clears the graphics area.
TOP —	which sets scrolling or paging on the text part of the screen.
LINE (parameters) —	which draws lines according to the parameters given.
PR N —	which outputs to a selected port/device (e.g: the RS232 port).
IN N —	which inputs to a selected port/device (e.g: the RS232 port, as above).

There is also the **IO** command, which inputs or outputs specified data to specified ports.

An, as yet, unpublished function of the unit is that the character ROM is capable of Arabic characters — including right-to-left movement of the cursor.

In addition to cassette, monitor, and disc outputs there are two general purpose interface connectors with an optional expander box supplied separately from the basic unit.

The 'input box', as it is called, is simply a circuit which translates eight discrete levels or switch states into a single byte which may be read at any time. It can also interrupt the processor. The output box is the reverse, translating a byte into eight relay closure states.

Peripherals

The thermal printer is fairly standard, being very similar to the ETI-641 project, with 32 character width. The one we had was supplied with silvered paper.

The card reader is a clever and economical design. It contains no motor, the source of most of the cost and complaints in card readers in general. The cards do have to be pushed through, but the reader is foolproof and hence seems to have all the potential for high reliability. The cards are, unfortunately, punched-hole rather than mark-sense, the reader accepting a wide range of card types, including Canon.

The cassette interface as supplied on the standard unit is the usual FSK format, though there is one super addition: The baud rate, normally 300, is definable by two bytes in RAM. It can thus be varied and this allows the optimisation of tape usage. The little Japanese-made cassette recorder we used would not tolerate much above 500-600 baud without high error risk, but a large unit might accept up to 1200. The maximum allowed is 1200 baud — and the minimum is two! (we imagine this would give astonishing reliability if you felt like waiting).

Another interesting application of this variable baud rate is recovery of programs which have been recorded on ▶

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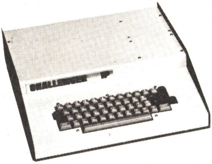


PERSONAL COMPUTERS

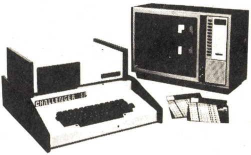
CIP: $459 A dramatic breakthrough in price and performance. Features OSI's ultra-fast BASIC-in-ROM, full graphics display capability, and large library of software on cassette and disk, including entertainment programs, personal finance, small business, and home appliances. It's a complete programmable computer system ready to go. Just plug-in a video monitor or TV through an RF converter, and be up and running. 15K total memory including 8K BASIC and 4K RAM — expandable to 8K.

CIP MF: $1657 First floppy disk based computer for under $1700! Same great features as the CIP plus more memory and instant program and data retrieval. Can be expanded to 32K static RAM and a second mini-floppy. It also supports a printer, modem, real time clock, and AC remote interface, as well as OS-65D V3.0 development disk operating system.

PROFESSIONAL PORTABLES

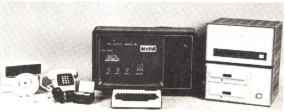
C4P: $849 The professional portable that has over three times the display capability of CIPs. Features 32 x 64 character display in up to 16 *colors,* graphics, audio output, a DAC for voice and music generation, key pad and joystick interfaces, AC remote control interface and much more. Utilizes a 4-slot BUS (2 used in base machine), 8K BASIC-in-ROM, 8K of *static* RAM and audio cassette interface. Can be directly expanded to 32K static RAM and two mini-floppy disks.

C4P MF: $1999 The ultimate portable computer has all the features of the C4P plus real time clock, home security system interface, modem interface, printer interface, 16 parallel lines and an accessory BUS. The standard machine operates at twice the speed of currently available personal computers (with GT option it runs even faster!) The C4P MF starts with 24K RAM and a single mini-floppy and can be directly expanded to 48K and two mini-floppies. Available software includes games, personal, business, educational and home control applications programs as well as a real time operating system, word processor and a data base management system.



HOME/SMALL BUSINESS SYSTEMS

C8P: $1099 Same great features as the C4P in a tremendously expandable "main-frame package." Features over three times the expansion capability of the C4P for advanced home and demanding business applications. Can be expanded to 48K RAM, dual 8" floppies, hard (Winchester) disks and multiple I/O devices such as Voice I/O and a universal telephone interface.



C8P DF: From $3149 The ultimate Home/Very Small Business Computer at a personal computer price. Features 32K RAM (expandable to 48K) and dual 8" floppy disks (stores eight times as much information as a mini-floppy). Has all personal computer capabilities including 32 x 64 display, color graphics, sound, DAC, joystick interfaces, home features including real time clock, AC remote interface, home security and fire detection interface and can be expanded to include voice I/O and a universal telephone system for answering and initiating calls! Its large memory capability and 8" floppies allow it to run most Ohio Scientific business system software including a complete accounting system, word processor and information management system.

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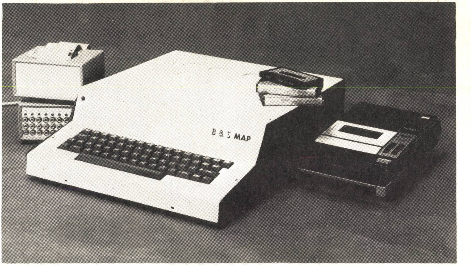
BRISBANE'S CALCULATOR/MICRO-MINI COMPUTER CENTRE

a tape recorder with sick batteries, which have slowed the tape speed.

Here are some user-installable options: There is provision for a 3000 — yes 3000 — baud cassette interface on one of the pc boards. It requires only a handful of ICs and some software, and claims greater reliability than the 300 baud standard type. The price is of course the fact that it is not standard, and thus you probably won't be able to swap programmes stored by it, but ...

The second user-installable option is a light pen. This requires only the pen hardware and the driving software, plus connectors if required. Unfortunately we were not supplied with the installation instructions, so we cannot comment on how easy or effective these two possibilities are.

There is an intelligent disc drive which is due for release soon. This is capable of serving up to 16 Mini-Maps, and will use the RS232 interface on the back of the unit. Unlike many disc systems this one consumes none of the system RAM, and thus doesn't reduce the machine's capabilities at all. It is likely to cost $1100, controller inclusive. There is also to be a PROM burner, capable of programming the species of ROM inside the Mini-Map. This however, is only at the prototype stage.



The Mini-Map shown with the input box and printer (sitting atop the input box). Any of the readily-available portable cassette players may be used with the system.

Manual

The manual supplied with the unit was a very rudimentary one. It is truly a user's manual, not an 'instruction' manual. It lists the commands available and notes the possible parameters etc, but it does not explain what a micro is or any general purpose information. In our opinion this limits the application of the unit to people who know about computer systems or are willing to find what is needed in a library.

Now, the nitty-gritty: prices.

Basic unit, 16K, all cables, RS232 and two Ports	**$1065**
Printer	**$270**
Card reader	**$114**
Input box	**$96**
Output box	**$96**
4K add-ons	**$117**

Further information can be obtained from B&S Micro Systems, 2/20 Emma Crescent Shopping Centre, Wentworthville, NSW. ●

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HARDWARE

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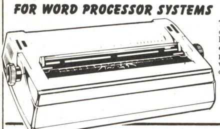

This superb unit is a self-contained printer with in-built asynchronous serial interface conforming to the established RS-232C standard. It prints on business stationery up to 380mm wide at the rate of 45-65 characters per second – three times faster than golf-ball typewriters. Top quality office systems printer that is below competition prices. . .

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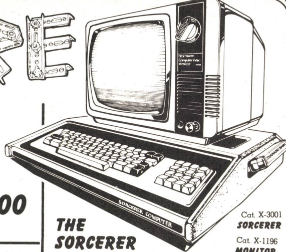
DICK SMITH Computer Video MONITOR
SORCERER COMPUTER

THE SORCERER

Cat. X-3001 **SORCERER**
Cat. X-1196 **MONITOR**

The Sorcerer is the expandable Z-80 based microcomputer that allows you to add peripherals to take it from basic computing through to advanced office business systems.
● 16K RAM expandable to 48K (on board) ● Serial I/O and Parallel I/O ● S-100 BUS compatible ● Cassette I/O for two recorders at speeds of 300 or 1200 baud ● Video I/O – 1920 characters full screen ● Full ASCII 128 characters (64 defined characters and 64 undefined characters) ● Graphic resolution 122,880 pixels ● Includes 8K BASIC plug-in ROM PAC™ in MICROSOFT™ ● Dimensions 490 x 330 x 100mm ● Weight 6 kilograms.
(Ask for our FREE comparison chart between the Sorcerer and other well known computer brands).

$1,395.00

LIGHT PEN FOR TRS-80 OWNERS

SCOOP PURCHASE of light pens from the USA – draw on the VDU – it's educational and fun. . .
● Uses your cassette recorder as a pre-amplifier ● Comes complete with cassette containing two application routines: TIC-TAC-TOE and 'menu' display routine ● Give your TRS-80 level II an 'eye' ● Uses 9V transistor battery (not supplied).

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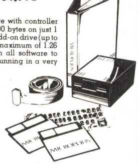
The Micropolis mod 2 drive with controller enables you to store 315,000 bytes on just 1 disc. By adding the mod 2 add-on drive (up to 3) you can obtain up to a maximum of 1.26 Megabytes! Complete with all software to enable you to be up and running in a very short time.

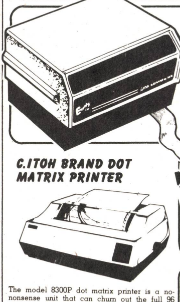


Model 1043/mod 2 with controller.
Cat. X-3205 **$1,350**
Model 1023/mod 2 add-on
Cat. X-3208 **$750**

VIDEO MONITOR

This is a superb 30cm black and white video monitor that can be used on AC and DC. Simple connection to your computer. Features jitter free and distortion free characters. Can be used with most computers on the market.

Cat. X-1196 **$149.50**



EXIDY S-100 BUS EXPANSION

By using plug-in cards with the S-100 BUS and your Sorcerer you can use many other manufacturers peripherals (see our special 'Blue Board' cards on this page). The world of computing has been made even more exciting through the S-100 BUS. Comes complete with in-built powre supply, ribbon cable and connector.

Cat. X-3010 **$499.00**

● Allows up to 6 plug-in cards ● Connects directly to Sorcerer's 50-way expansion socket via supplied cable ● All S-100 lines fully buffered ● Separate 2.000MHz crystal clock provided for S-100 cards which cannot use the Ø1 and Ø2 clock signals derived from the Sorcerer's 2.106MHz clock ● Provision for mounting up to six 25 pin "D" connectors for additional I/O ports, etc.

WORD PROCESSOR PAC™

Remove the plug-in BASIC PAC™ and replace it with the powerful WORD PROCESSOR PAC™ and you will have the basis of an office computer system.
Features: ● Automatic text wrap ● Automatic checking of drastic commands ● Powerful search function ● Auto commands ● Macro programming – all this plus extensive user instructions.

Cat. X-3085 **$275.00**

SPECIAL WORD PROCESSOR KEYS

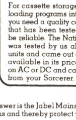
To enable you to use the Sorcerer's Word Processing function more readily we can supply specially embossed keys (11 units) to replace the normal beige keys. The colour allows you to identify the special keys immediately. Just another touch of professionalism for the Sorcerer owner. . .

Cat. X-3086 **$14.95**

C.ITOH BRAND DOT MATRIX PRINTER

The model 8300P dot matrix printer is a no-nonsense unit that can churn out the full 96 character ASCII at a brisk 125 characters per second on standard fan-fold paper. Character spacing of 80, 40 or 132 columns which are software selectable. A quality unit that costs less than $1,000!!

Cat. X-3255 **$970.00**



DYNAMIC EXPANSION KITS

These are top quality ICs that can expand your basic 16K Sorcerer to 32K or even 48K (expands the 8K to 16K etc). They can also be used with the TRS-80 level I and II and the Apple II computers to expand their on-board RAM. Superb value and complete with installation instructions.

Cat. X-1185 **$109.50**

CASSETTE RECORDER

$79.95

For cassette storage of data, or for loading programs into your Sorcerer you need a quality cassette recorder that has been tested and found to be reliable. The National Panasonic was tested by us along with other units and came out as the best unit available in its price range. Works on AC or DC and can be controlled from your Sorcerer.

Cat. A-4095

JABEL COMPUTER MAINS FILTER

Having trouble with memory crashes? Then the answer is the Jabel Mains Filter – it will remove those annoying spikes from the 240V mains and thereby protect your memory!

Cat. M-9850 . . . . **$75.00**

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Connect 2 cassette recorders to your Sorcerer and be able to control them both from your computer keyboard.

Cat. X-3110 . . . . **$34.50**

PRINTER INTERFACE CABLE

Connect your Sorcerer to the C.ITOH printer or any Centronics compatible printer.

Cat. X-3112 . . . . **$49.50**

SEE OPPOSITE PAGE FOR DICK SMITH STORE ADDRESSES

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2 PARALLEL & 2 SERIAL I/O BOARDS

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Microprocessors invade the machine shop

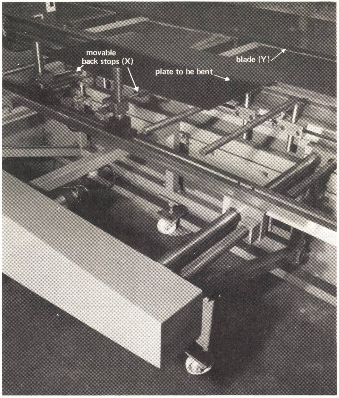
"The ubiquitous micro will soon be more numerous than the cockroach", said a very sagacious acquaintance — and he may well be right.

In view of the publicity about the way the 'microprocessor revolution' is going to affect our lives, ETI thought it would be a good idea to examine what was happening in an industry which is traditionally slow to react to technological advances — the machine tool industry.

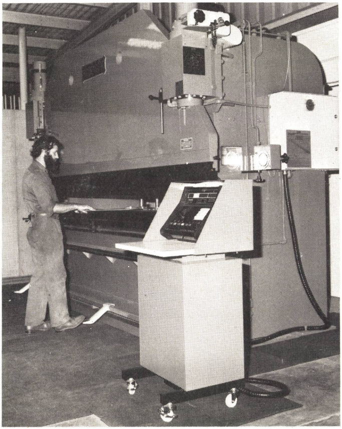
We spoke to Mr John Drolz, Managing Director of Pearson Machine Tools, a Sydney-based firm, to see where the micro was making its presence felt on the machine shop floor.

Pearson Machine Tools manufacture a line of 'press brakes'. These are machines used to bend sheet metal at differing angles to conform to a certain design shape. Press brakes are widely employed in the metal fabrication industry.

The particular Pearson machine we looked at is capable of bending mild steel sheet up to 10 mm thick, requiring about 200 tonnes pressure to obtain a right-angle bend.



The plate to be bent is placed in the machine such that its rear edge sits against the back stops. When the operator presses the foot switch the blade descends a pre-programmed distance, bending the plate. When the blade ascends, the back stops are repositioned a pre-programmed distance from the blade, ready for the next bend.



The Pearson microprocessor-controlled press brake in use.

Generally, press brakes are manually operated and are set to bend a single angle at a time with work progressing on a batch basis until each plate is formed to the required shape. This results in much time being lost on setting up the machine since typical jobs require many bends of different angles on the same piece of metal.

The multiple handling and storage space requirements of jobs in progress is very inefficient and so Pearson have introduced a programmable microprocessor control system for the press brake.

John Drolz claims that production times are reduced to nearly one half when using the microprocessor control system as it allows the machine operator to form bends sequentially on the individual pieces of metal, creating a 'raw material input — finished product output' situation.

The operator of a press brake inserts a sheet of metal horizontally into the machine until the back edge touches an adjustable back stop. A hydraulically driven blade descends and presses the sheet into a vee-shaped groove beneath the sheet. The distance of the descent determines the resulting bend angle and the position of the back stop defines the bend position.

The Pearson ANC microprocessor controls the position of the back-stop and the blade to an accuracy of 0.01mm by means of dc servomotors.

The operator programmes the microprocessor with the bend sequence before the start of a job and thus the time-consuming work-handling operations and individual settings of the controls are eliminated. ▶

The ANC microprocessor press brake controller. The machine is programmed by the operator using a test piece, working from engineering drawings of the required plate shape.

John Drolz points out that the operator maintains his self respect as a skilled man since he is called upon to use his practical experience in programming the machine. He sees this reason as very important to acceptance of microprocessor control on the machine shop floor.

The Pearson microprocessor is of a very rugged construction, in keeping with the normal environment in metalworking shops, and is claimed to be virtually foolproof and easily serviceable, plus it permits full manual control as well as the automatic mode of operation.

The processor is an X-Y controller with a six kilobyte memory, programmable for up to 100 steps. At present, the electronic hardware is imported from Switzerland, though the press-brake is manufactured here.

It seems there are many Australian companies which would like to use microprocessor control for specific applications, such as the one just discussed. The problem is that nearly all the purpose-built controllers are designed and built abroad. The foreign manufacturers are producing equipment aimed at a large, world-wide market and the specific needs of Australian companies may be overlooked or the equipment is too powerful or otherwise unsuited to local applications.

There's a market out there just crying out for products. If you think you've got it, or can make it — go out and sell yourselves!

Who's selling what

Vicom Pty Ltd are distributing a Tono Dot Matrix Printer, model HC800, for around $970. The specifications include: upper and lower case, 125 characters seconds, programmable character width and vertical format and 80 byte character buffer. Phone Sydney (02) 436-2766 or Melbourne (03) 699-6700.

Remington Office Machines have a new daisy-wheel printer, the RP1600, for under $2000 with six different wheels available. (02) 20925.

Daneva Control Pty Ltd announce a low cost keyboard in word processor format with 70 or 72 keys. Both keyboards have solid-state switching, four levels of ASCII encoding with options of parallel and serial outputs with RS232 or current loop. (03) 598-5622.

Micro Products is now respresentatives for Dennison Kybe 200 mm flexible disks, digital cassettes and magnetic cards, in addition to providing software support for microprocessor users. They live in P.O. Box 8, University of New England, Armidale NSW.

Dick Smith has an extension to the 'Sorcerer' microcomputer so you can have a cassette-based word processor with top quality diasy-wheel printer for $5500. Changing from computer to WP is a matter of plugging in a special ROM PAC cartridge.

Royel Micro Systems have a new, low-cost microprocessor development system, the MTD1000. It features a resident assembler/Editor which produces relocatable machine code — this can be used directly or burnt into EPROM. Source code may be entered and modified and in a addition a program may be written in BASIC and a machine code routine called with a USR function call. Call them on (03) 543-5122 for full details.

The Dindima Group are now representatives for the Anderson Jacobson range of terminals and recorders including the AJ510 CRT terminal with 450 mm monitor, graphics character set, editing capability, selectable data rate of 9600 b/s and self-test diagnostics. (03) 873-4455.

Software news

This month sees the formation of a new company in Sydney exclusively concerned with servicing the enormous number of TRS-80 users in Australia.

CISA, Complete Information Service of Australia, has commenced with a large teaching library of books, a full range of disks and cassettes for the TRS-80 (games and commercial), and many hardware mods for the basic Tandy machine.

Mr Eric Akroyd, the Managing Director, is bubbling with enthusiasm and ideas and is currently selling such goodies as light pens, an automatic telephone dialling system, memory expansion to 16K, Data debug, plus he will also fit your lower case display at the drop of a hat! The address is 159 Kent St., Sydney (02) 241-1813.

Another software company specializing in a particular micro is Microbyte of Canberra.

Their forte is the 2650 and they have just released four programs which should be of interest to many readers: an Audio Cassette Operating System, which offers very fast data transfer, high reliability, named files and motor control together with minimal hardware interface; an Editor / Assembler with up to 1024 symbolic labels — it allows object code to be output to memory, tape or disc.

The Microbyte source generator will produce source code which can be reassembled by the Assembler. Their BASIC program will allow cassette data files to be generated and read in BASIC. Further information from Microbyte, P.O. Box 274, Belconnen, ACT.

Edible space invaders?

Melbourne-based supplier, Edible Electronics, is being overrun by their latest software addition: Space Invaders.

To commemorate the formation of the Commodore User Group, they are offering the 8K PET at a special low price. In addition, the popular pinball parlour game 'Space Invaders' is being included in the free program pack which comes with every PET.

For further information contact Joel at Edible Electronics, P.O. Box 1053 Richmond North, Vic 3121. (03) 41-5708.

to p.101 ▶

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We believe that we have the best and most comprehensive range of titles of interest to the TRS-80 owner/user. Over 200 titles presently in stock.

Highly Recommended

BASIC and the Personal Computer — Dwyer and Critchfield	$ 14.95
Programming in Pascal — Grogono	$ 11.95
The Little Book of BASIC Style — Neveson	$ 7.25
Problem Solving and Structured Programming in BASIC — Hoffman & Friedman	$ 12.95
Z80 Microcomputer Handbook — Bardin	$ 11.95
Microprogramming and Software Development — Duncan (Highly recommended)	$ 34.95
Introduction to the TRS-80 Computer — Zabinski	$ 14.95
Microcomputer Primer — Waite	$ 10.75
60 Challenging Programs with BASIC Solutions — Spencer	$ 8.50
Sargon A Computer Chess Game — Spracklen	$ 20.00
Game-Playing with BASIC — Spencer	$ 11.00
BASIC Wordbook for Beginning Programmers — Schomann	$ 8.00
Calculators and Computers — A Source Book of Activities	$ 10.95
Microcomputers and the Three Rs — Doerr	$ 10.00
S100 Bus Handbook — Bursky	$ 10.00
Microprocessor Data Manual	$ 10.00
Small Computer Systems Handbook — Lihes	$ 11.50
Pascal with Style — Legard and Nagin	$ 8.50
Basic BASIC — Coan	$ 12.00
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This DOS is the finest we have seen for a microcomputer. Has features and facilities previously restricted to much larger systems.

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This is professional quality software and really provides a superb business system for the TRS-80. Software maintenance is available to purchasers of the complete system at $15.00 per hour, to tailor these programs to your specific needs.

GAMES

Sargon	$ 25.00
Sargon II	$ 37.50
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Strategy Games (5)	$ 7.97
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Tuition includes assignment work if required — and assessment.
A certificate of competence is awarded on successful completion of a tuition series.

We are currently preparing a correspondence course in BASIC for out-of-town TRS-80 users. Details will be available shortly.

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General Instrument's* NEW! 'Thinking Cap' Keyboard

General Instrument's Keyboard Division has combined state-of-the-art microprocessor technology with the reliability and simplicity of capacitive keys to create a highly flexible, low cost keyboard for OEM's and hobby projects.

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daneva control pty. ltd.
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Ohio Scientific dealer network is Australia-wide

For more information and advice call on your local dealer to help you select the best system for your needs

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31 Hume Street, Crows Nest, N.S.W. 2065

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Micro Data EAST PERTH 328-1179
Micro Solutions SUBIACO 381-8372

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Computer Consultants, 3 Wolfe Street, Auckland. N.Z. Phone: 79-8345
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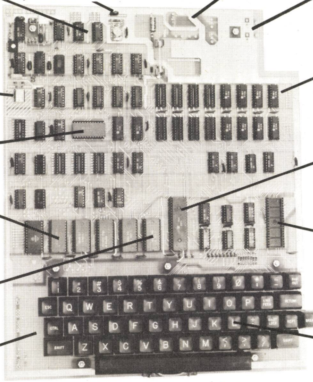
TOMORROWS TECHNOLOGY TODAY
OHIO SCIENTIFIC

The Superboard
Ready to go, ready for more



Cassette interface, 300 Baud Kansas City standard, so you can swap programs, ask your dealer how to double the speed!

Space for printer port. Again ask your dealer. He will show you how to use it.

All you need is a 5v power supply.

RF Modulator Connection.

4MHz crystal

4K of RAM on-board space for a further 4K ready socketed. Just plug in the chips.

Character generators giving a full 256 characters from Alpha-numerics to planes, guns and spaceships.

6502 processor chip as in four out of five of the top selling personal computers.

Monitor ROM, allowing you to enter machine code.

Your connection to the expansion facilities, up to 32K of RAM, dual disks and the outside world.

8K BASIC available on power up with floating point, trig functions, multi-dimensioned array, and full string facilities.

Full 53 keyboard with upper case, lower case and graphic elements. Drive it in polled mode and you can detect up to eight keys pressed simultaneously – how's *that* for real-time games?

Joystick interface. It gives a 'natural' feel to game manoeuvres like driving a tank, firing a rocket.

Our Superboard lets you suit yourself, offering a ready to go configuration that you can add to as needed. The Superboard is the first complete personal computer system contained entirely on a single board.

This is a major electronic breakthrough and we at Ohio Scientific accomplished it by using custom state-of-the-art LSI micro circuits. The Superboard offers you more features than many of the more expensive alternatives.

We designed the Superboard specifically with versatility and economy in mind. It is suitable not only for the serious computer user, but also for first time users, the student or the hobbyist. The Superboard gets you off to the right start, and you can add to it later – saving money all along the line.
If you're just starting, get the ready-to-go CI model, then all you'll need is your cassette and television set and you're into the world of computers in a really serious and flexible way.

For the complete list of dealers, please refer to listing on opposite page.

TCG
TOMORROWS TECHNOLOGY TODAY

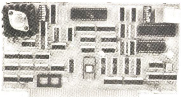
OHIO SCIENTIFIC

LOCKWOOD TCG4606 A

Australian Dealer: Systems Automation Pty. Ltd. 31 Hume Street, Crows Nest, N.S.W. 2065 Phone: 439-6477

ELECTRONICS BY MAIL

Z80 SINGLE BOARD COMPUTER



Build your own Z80 based home computer using the ETI/DGZ80 as described in ETI November 1979. Designed by David Griffiths, this is probably the most powerful S100 Z80 magazine project described to date.

Features include on board P10 (dual 8 bit 1/0), CTC (4 channel programmable counter timer), power on jump, software write protect option, provision for 2K ROM on board, 1K RAM for stack, scratchpad (expandable to 2K) top quality solder masked plated through PCB, sockets for all IC's and comprehensive Owners Manual.

DG Z80 (kit)	$199.25	tax paid.
(kit)	175.00	tax exempt.
(assembled)	240.00	tax paid.
(assembled)	215.00	tax exempt.

DGOS OPERATING SYSTEM

Monitor ROM for above DG Z80 strongly recommended for use with DG 640 VDU. Powerful monitor includes tape loading/dumping real time clock, software write protect, memory examine, alter, compare, move and fill commands.

2716 EPROM with listing $48.00.

DG 640, VDU

This has to be the most popular VDU in Australia. Described in ETI March 1978, the DG 640 features 16 lines of characters, upper/lower case with graphics, crystal locked self contained TV scan circuits, top quality plated through PCB with Owners Manual.

DG 640 (kit)	$139.50	tax paid.
(kit)	125.70	tax exempt.
(assembled)	149.50	tax paid.
(assembled)	134.25	tax exempt.

NOTE: ALL PRICES INCLUDE SALES TAX (Except where noted)

VOLUME SPECIALS

(Offer closes 30/6/80)

IN914 diodes	20 for $1.00.
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RED leds	10 for $1.50.
555 Timers	4 for $1.00.
2102 RAMS	8 for $11.25.
2114 – 450.	2 for $10.75.
4116 – 300.	8 for $89.50.

DREAM 6802

Described in EA May 1979, this kit has been redesigned to accept the 6802 chip and eliminate the problems with the 6875 IC. The Applied Technology DREAM 6802 includes all IC's, components, keyboard modulator and power supply, together with a comprehensive MANUAL and simple program to run.

DREAM 6802 (kit) $149.50 tax paid.

CRYSTALS

1MHz	$12.50.
4MHz	7.95.
8 MHz	7.95.
12 MHz	7.95

(Small stocks of other values.)

ZENER DIODES 1w.

ALL VALUES 25¢.

3V3, 3V6, 4V7, 5V1, 5V6, 6V2, 7V5, 8V2, 9V1, 10V0, 11V0, 12V0, 13V0, 15V0, 16V0, 18V0, 20V0, 22V0, 24V0, 27V0, 30V0, 33V0.

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JUST WRAP KIT	$32.15.
WSU-30w. WIRE WRAP TOOL	8.75.
WIRE WRAP WIRE 50 ft. spools. (red, black, blue, white)	2.75.
WIRE WRAP TRIPLE PACK DISPENSERS	8.75.

MICROPROCESSOR COMPONENTS

Z80 CPU	$15.75
Z80 PIO	9.75
Z80 CTC.	9.75
2650A.	15.75
2608 PIPBUG	15.75
2651	19.75
2708	12.50
2716 (+5V)	45.00
2114-450.	5.75
2102-350	1.55
SC/MP II	9.75

SOCKETS

	Solder	Wirewrap
8 pin	25c	75
14 pin	33c	83c
16 pin	35c	90c
18 pin	50c	95c
20 pin	60c	$1.30
24 pin	75c	$1.90
28 pin	80c	$2.20
40 pin	$1.00	$2.40

LOW POWER SCHOTTKY

74LS00	.30	**74LS109**	.70
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74LS03	.30	**74LS123**	1.50
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74LS95	1.40	**74LS374**	2.95
74LS96	1.60	**74LS375**	1.25
74LS107	.70	**74LS386**	.95

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RED	25c
GREEN	35c
YELLOW	35c

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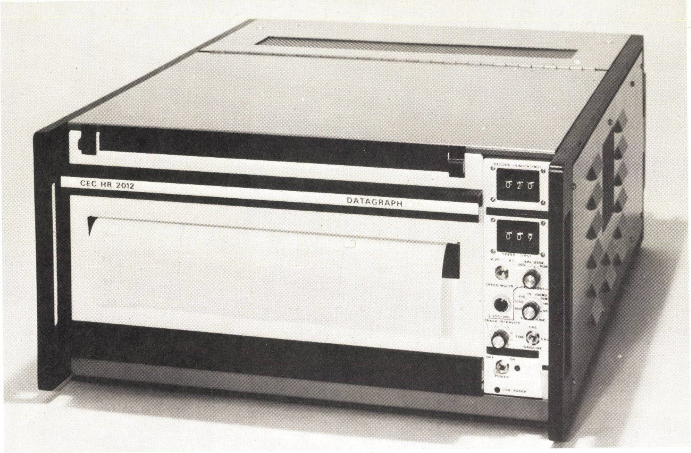


Solid-state recorder is a first for B. & H.

Bell & Howell say their HR-2000 Datagraph is the first all solid-state graphic recorder produced.

The machine employs an array of solid-state, digital light 'shutters' placed in line above light-sensitive recorder paper. Data signals open a shutter to allow a spot of light to fall on the paper and expose it.

Each gate is individually programmable. Thus, for example, when all shutters are opened simultaneously, a line is drawn across the paper.

The principle of operation is illustrated in the accompanying figure.

The programmable light gate array is a sandwich consisting of opposing polarizing filters applied to either side of a precision pattern of electronic "gates". These gates are produced at a density of 32 per 50 mm on a clear crystalline base by thin film deposition.

Applying a voltage to the gate terminals establishes an electric field across the crystalline structure within the gate area. The resultant structure alteration rotates the wavefront of collimated light passing through the gate so that it becomes complementary to — and passes through — the normally opposing output filter to the recording paper.

Incoming analog signals are directed to voltage-to-time converters. These circuits impress the data on a ramp voltage which effectively assigns the signal to a specific gate — or sequence of gates — in accordance with the original signal amplitude-to-time relationship. The final result is a trace recording of the original data waveform.

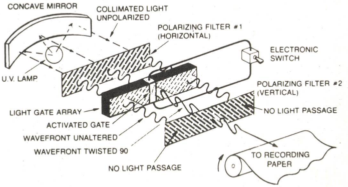
The maximum speed of operation of each shutter is 20 microseconds which means that the HR-2000 recorder has a bandwith of 5 KHz.

The machine accepts paper widths of 300 mm and up to 28 channels can be recorded simultaneously. Input impedance is 10 k shunted by 10pF and paper speeds of 0.3 mm/s to 3 m/s are possible.

The new system is completely non-mechanical and therefore the trace is linearly related to the electrical signal and overshoots on step waveforms are eliminated.

Further information direct from Bell & Howell, branches in each state.

▶



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Check these incredible features:

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Printout

IC reference operates at 12 uW

National Semiconductor Corporation has developed a new series of 1.2 V voltage reference diodes.

Using ion implant technology, this series has been designated LM185/285/385 series and these diodes can operate from 10 uA to 20 Ma with virtually no change in performance, National claim. Dynamic impedance is typically only 0.5 ohms and on-chip trimming gives tight tolerance at no extra cost.

This diode is particularly useful in battery-powered applications where the combination of low voltage (1.2 V) and low power drain (12 uW) extends battery life.

This new series was designed to operate properly with shunt capacitance, overcoming a problem that exists with many older devices that oscillate when capacitively loaded.

The temperature coefficient of the devices is only about 10 ppm. Internal trimming of the diodes, within 1% tolerance for military and "B" versions, and within 2% for the low cost version is another feature of the LM185.

Rated for operation over the full military temperature range, the LM185 series is available now, either in a two-lead T0-46 hermetic package, or for commercial applications in a T0-92 plastic package.

Price of the LM385Z, when ordered in 100-up quantities, is $1.20 each and further information can be obtained from Ed Schoell in Victoria on (03) 729-6333, or Chris Mason in NSW on (02) 93-0481.

New TRS-80 magazine

A new monthly magazine devoted entirely to those Australian hobbyists possessing a Tandy TRS-80 or a Dick Smith System 80 has appeared on the market — Micro-80 (insert synthesizer fanfare here).

The magazine is proudly independant of commercial interests and enthusiasts will appreciate its racy and relevant articles on software and hardware hints.

For example, the latest issues contain programs for computer games, assembly language programming, a stock recording system, a light pen for $4 and hints on memory space saving.

The readers' letters section is a real turn on — a great information exchange. Costs $2.50 from P.O. Box 213, Goodwood S.A. 5034.

Order entry/invoicing debtors system

IMS Computer Systems, (the microcomputer division of Integrity Management Services Pty Ltd) the Melbourne based software house, has released version 2.1. of its integrated order entry/invoicing, debtors system.

There is now provision for multiple selling prices, multiple discounts per stock item depending on debtor category, override discount percentage, debtor credit limit and date of last payment.

New reports include commission and sales by salesman, customer purchases this month and year-to-date etc.

The system displays an outline of the invoice on the screen and the operator "fills in the blanks". The sophisticated features offered in version 1.0 have been retained. These include profitability per stock line, sales analysis by product and product guide, taxation payments for the various categories, freight, insurance and so on.

For users of version 1.0 an upgrade to V2.1 is available for $300, which includes a new manual and program to convert V1.0 files to V2.0 format, as well as the new programs. Standard stationary is utilized and can be supplied with or without the user company name pre-printed.

The order entry/invoicing system is $700 and the debtors system $300. Both packages operate on a "stand-alone" basis or can run totally integrated.

The release of V2.1 complements the existing commercial software which includes general ledger, creditors, payroll, direct mail, reservations and word processing packages.

As with all IMS packages, the programs are designed to run under the CP/M operating system, on most commercially available micro systems.

Further information can be obtained from the head office of IMS in Melbourne.

Protect your micro

If you suffer from paranoic dreams that your darling microprocessor is going to leave you one of these stormy nights, then perhaps you need high energy protection.

When lightning strikes and a transient spike comes down the line, a high frequency filter such as the Sprague FN332Z-601 will probably help your gear stay together a bit longer.

Electronic (distributors) state that this filter is specified to protect digital circuits against both common-mode and differential-mode power line pulses.

It features a metal oxide varistor connected beween line and neutral and is designed for line currents up to 6A (leakage current:

Brisbane happennings

The Microprocessor Interest Group of the IREE and TAFE are arranging a series of courses on microcomputers to be held in Brisbane starting on 2 June.

The courses are designed so the subject is fully covered and students are expected to progress over a period of time from basic digital electronics to microcomputers then to systems, programming in BASIC and finally to software at the assembly/machine code level.

The courses will last ten weeks and will include practical work.

Micromaniacs at all levels of knowledge are most welcome if enthusiastic, so why not call in the TAFE office at the Old Brisbane Town Hall and get the details?

The Microprocessor Interest Group has regular meetings on the second Friday of every month, at the same place, to exchange information etc. ●

AMPEX 360

Professional Series Cassettes

- Low noise/high output
- Wide dynamic range
- Ferrosheen TM polished oxide surfa
- Superior quality shell and componen

HERE IS A UNIQUE OPPORTUNITY to obtain world-famous AMPEX tape cassettes at truly bargain prices.

The AMPEX 360 series are standard tape cassettes but made to professional standards using professional grade materials. They are made specifically for applications in which consistent and reliable performance is as essential as top quality electromagnetic properties. The tapes are of course completely suitable for all general purposes – the main difference between AMPEX 360's and many other tape cassettes is that these are made properly!

The Ampex Professional Series cassette has a wide dynamic range due to its low noise/high output oxide formulation, providing clean, well defined response across the spectrum.

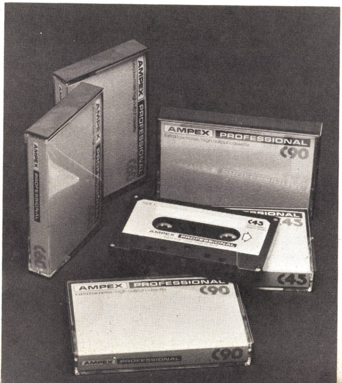
The recording surface is polished by the exclusive Ampex Ferrosheen TM process to produce a glass-slick oxide surface that achieves close tape-to-head contact, maintaining sound fidelity.

The shell, and its internal components, are precision products designed for the highest mechanical reliability. The pressure pad system is a felt/beryllium copper spring assembly. Rotating guide rollers run on lubricated stainless steel pins.

A special formulation in the interior top and bottom liners reduces tape edge friction and minimises possible wow and flutter. The cushioning effect created by the liners helps to reduce mechanical noise to a practically inaudible level. The convex shape of the liners causes a spring-like action which controls tape torque and tape alignment and helps in forming a uniform tape pack for smooth, jam-free operation.

The cassette shells are assembled with five screws to maintain precise internal dimensional uniformity. The shell may be dis-assembled for editing or splicing if required.

Windows, which allow visual inspection of the tape packs, are made of solid transparent polystyrene to protect the tape from dust.



CHARACTERISTICS	SPECIFICATION	
CASSETTE TAPE SYSTEM		
PLASTIC SHELL		
Dimensions:	Manufactured in conformance to Philips Dimensional Standards.	
Materials of Construction:	High heat, medium impact polystyrene.	
Torque Control Liners:	Graphite coated, preotensioned polyester.	
Pressure Pad Assembly:	Felt/Beryllium copper spring.	
Magnetic Shielding:	Full-width steel.	
Closure Method:	5-screw assembly.	
Tape position Windows:	Rigid polystyrene. Welded.	
Tape Guide System:	Rotating guide rollers operating on lubricating stainless steel pins.	
SYSTEM PERFORMANCE		
Rotating Torque:	Less than 25gm/cm without hold-back.	
Wow and Flutter:	Less than 0.10% DIN weighted.	
INTRINSIC MAGNETIC OXIDE PROPERTIES		
Coercivity (Hci) in oersteds	290	290
Retentivity (Brs) in gauss	1100	1100
Erasure (1000 oersted field) in db	−60	−60
PHYSICAL PROPERTIES		
Base film thickness in mils	0.50	0.30
Base film type	Tensilized polyester	Tensilized polyester
Oxide coating thickness in mils	0.20	0.17
Total thickness in mils	0.70	0.47

AMPEX CASSETTES

SPECIAL READER OFFER!

Offer repeated by reader request

Each cassette is packaged in a trans- rent "Norelco" container. The insert bel is reversible, providing space for ogramme contents and title to be itten or typed.

Dindy Marketing has arranged with npex for Dindy to offer these tapes to ır readers for a limited period of time, nd at genuinely bargain prices. ectronics Today International has sted these tapes and supports Ampex's aims for performance and quality.

NOTE: Dindy has available ex-stock 10,000 C45s; 30,000 C60s; and 0,000 C90s. If demand exceeds indy's stock, Ampex has agreed to nake further supplies available to Dindy ithin two weeks notice.

Due to the extreme care taken in anufacture, it is extremely unlikely at any faulty cassettes will be found — the improbable event that you receive faulty cassette, Dindy guarantee to place it (at their discretion) within 30 ays.

his offer is made by Dindy larketing and this magazine is cting as a clearing house for orders nly. Cheques should be made out 'Ampex Offer' and sent together ith the order form to 'Dindy ffer', Electronics Today Int., 5 Boundary Street, Rushcutters ay, NSW, 2011. ETI will process e orders and pass them on to indy who will send out the goods y road transport or certified mail. lease allow approx. four weeks r delivery.

SPECIAL BARGAIN PRICES

Quantity	1 – 29	30 – 99	100 +
C45	$1.49	$1.41	$1.34
C60	$1.69	$1.61	$1.56
C90	$1.99	$1.89	$1.84

Packing & Delivery . . . . $2.50 any quantity

You may mix quantities of tapes of different lengths to make up an order in the quantity breaks given above to take advantage of the discount available.

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Please make cheques/postal notes payable to 'Ampex Offer' and send together with the order to 'Ampex Offer', Electronics Today International, 15 Boundary Street, Rushcutters Bay, NSW 2011.

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If you're an advertiser with a message for men that demands maximum reach, it's assured with a unique magazine buy from Murray/Modern Leisure Press.

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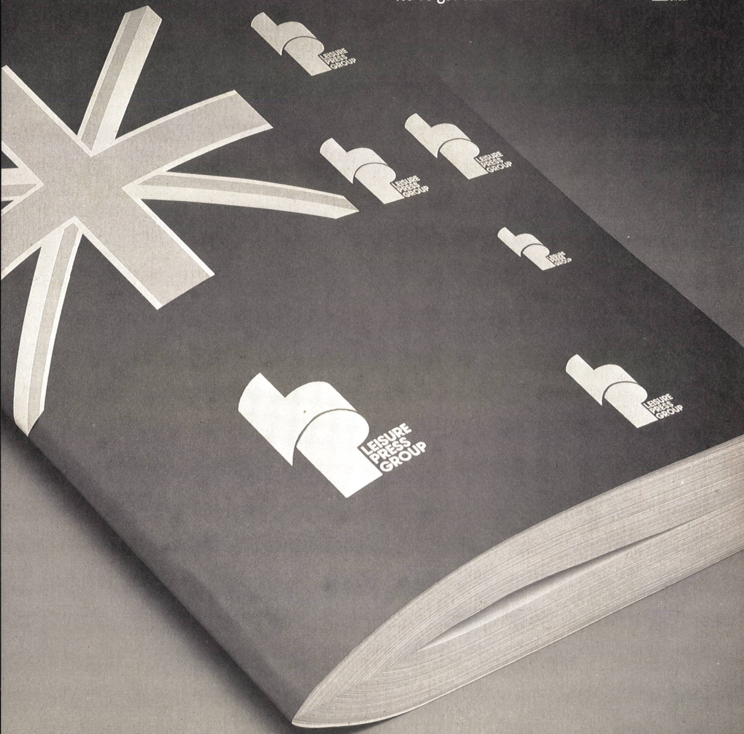

SYDNEY: Peter Treweeke or Max Press (02) 29 3761 MELBOURNE: Michael Orr or Andrew Fletcher (03) 690 6333
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COMMUNICATIONS

New programmable scanner has many features.

The Model SX-200 programmable VHF/UHF scanning monitor receiver, from J.I.L., is a new release from Melbourne firm, G.F.S. Electronic Imports.

The SX-200 looks very much like its predecessor, the SX-100 which we reviewed last November. This model has many new features.

This receiver is the 'next generation' model to the SX-100 scanner we reviewed in the November 1979 issue of ETI.

The SX-200, whilst very similar in appearance to its predecessor, has a number of features, not incorporated in the SX-100, that would seem very attractive to the Australian VHF/UHF scanning enthusiast.

Firstly, the SX-200 provides selectable FM and AM detection (with different IF filters, to suit). That's a big plus: it also features programmable scanning limits within a band (rather than having to scan the whole band), channel seeking 'up' or 'down' in frequency as desired, a fine tuning control, selectable squelch operation (see later), a recording output with control connection (operated from squelch) plus extended frequency coverage in four bands.

The four frequency bands, and channel spacings, covered are:

(a) 26-57.995 MHz in 5 kHz channels.

(b) 58-88 MHz in 12.5 kHz channels.

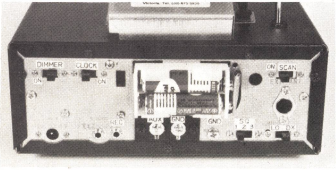
(c) 108-180 MHz in 5 kHz channels.

(d) 380-514 MHz (12.5 kHz ch.).

The display is the same as the SX-100, but controlling it is arranged differently on the SX-200. The display will show frequency to the nearest 5 kHz for five seconds after a channel is selected. At other times, the display will show the time ('clock' mode). During scanning or seeking modes the channel frequency is displayed. If the receiver stops on an occupied channel during scan or seek, the frequency will be displayed continuously unless the CK button is pressed, when the time will be displayed.

It's a very cunning, and convenient, system.

The same goes for the selectable squelch operation. On the rear panel of the SX-200 is a slide switch marked "SQ 1 2 3". When this switch is set to 1 and the unit operated in the scan or seek modes, the receiver will stop on a channel when the squelch is opened by a signal — regardless of whether the signal has modulation on it or not. When the SQ switch is set to position 2, and the unit is in the seek or scan mode, the receiver will stop on a channel containing a signal, as for position 1, but the audio will only operate when the signal is modulated. With the SQ switch on 3 the receiver will only stop on a channel if a modulated signal is received.



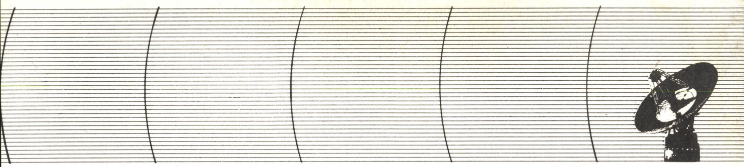
The rear panel of the SX-200 showing all the function switches, etc.

The scan delay control switch comes into play here. When switched on, the circuitry delays resumption of scanning for four seconds following a pause in transmission when the receiver is stopped on a channel in the scan or seek modes.

Also on the rear panel are REC and AUX connections. The REC socket accepts a standard 3.5 mm jack plug for a tape recorder input. The AUX screw terminal connector can be used to automatically stop and start a tape recorder when the receiver squelch is opened by a signal — no matter whether you're sitting on a fixed channel or operating in the scan or seek modes.

Just for the record, the unit also has an antenna attenuator switch on the rear panel, providing 20 dB of attenuation in the LO position and full gain in the DX position, along with a battery compartment containing two 1.5 V AA cells to supply the memory when the unit is switched off. The latter will maintain the 16 channel memory for months and are readily accessible, unlike the internal mercury cell as used in the SX-100. A very convenient change, that.

The SX-200 has programmable scanning limits allowing you to scan limited segments of a band, rather than whole bands as with the SX-100. You can also



scan up and down in frequency at will, rather than up only.

Claimed sensitivity of the unit on FM is 0.4 uV for 12 dB S/N on VHF and 1 uV for 12 dB S/N on UHF; on AM it's 1 uV on VHF and 2 uV on UHF, for 10 db S/N ratio.

The unit supplied for review came with its own test report from the factory, showing sensitivities of 0.4 uV for around 20 dB S/N for FM on VHF 1 uV for 16 — 18 dB S/N for AM on VHF; while for the same input levels on UHF, AM performance showed a 12.5 — 17.5 dB S/N ratio and FM a 14 — 20 dB S/N ratio. Measurements in the ETI laboratory substantially confirmed those figures

All in all, the SX-200 is a worthy successor to the SX-100 and includes a host of desirable features. Further enquiries should be directed to G.F.S. Electronic Imports, 15 McKeon Rd, Mitcham Vic 3132. (03) 873-3939.

Roger Harrison, VK2ZTB

Review of CB radio frequency policy

The Government is to review the policy on the most appropriate radio frequency arrangements and regulations for the Citizens Band Radio Service.

Announcing this late in March, the Minister for Post and Telecommunications, Mr Tony Staley, said that submissions would be sought from all sectors of the community.

The Minister, Mr Staley.

The Minister said that when the CBRS was introduced on 2 June 1977 the Government indicated that the service would use both HF and UHF frequencies. It occupied 18 channels at 27 MHz in the HF band and 40 channels at 477 MHz in the UHF band. Use of the 27 MHz service was to end in June 1982.

Mr Staley said that he had long been concerned that the decision to move the service out of the 27 MHz area in 1982 would be potentially unworkable.

"I have frequently reiterated this view in meetings with user groups, CB organisations and relevant sectors of industry" he said.

"I have always intended to review the matter at the end of the World Administrative Radio Conference (WARC), which was held in November last year. This announcement gives effect to this long-standing undertaking".

The Minister noted that the introduction of CB radio had led to some interference to television and other electronic equipment.

"I believe that the position has now stabilised", he said. "The level of complaints in recent times has fallen quite considerably.

The Government had learnt from the introduction of the CB service, and the P & T Department had arranged for further staff increases to ensure proper management of the radio frequency spectrum.

"In keeping with these developments the Government is now seeking to fully canvass all viewpoints before any final decisions on the frequency arrangements for CB are taken," Mr Staley said.

"After considering the public's submissions, my Department will prepare a report which will be published and circulated for further comment."

Details of where to send submissions and of closing dates would be widely advertised within the media, and major user organisations and business interests would be notified in writing, the Minister concluded.

Terms of Reference

To report to the Minister for Post and Telecommunications as soon as possible on whether the present 18 channel 27 MHz Citizens Band Radio Service, which was established on 2 June 1977, should be retained after June 1982.

In considering this issue regard should be had to:-

(1) all matters associated with the technical operating conditions, regulations, frequencies, channel allocations and procedures governing the Citizens Band Radio Service in both bands;
(2) the need to utilise and manage the radio frequency spectrum for the maximum overall benefit to the Australian community;
(3) Australia's international obligations in radio frequency management; and
(4) the need to minimise interference to other services.

New analyser extends range

Marconi's new spectrum analyser, model TF2371, retains all the features of the well-known TF2370 but extends the frequency range up to 200 MHz. This is particularly useful in the fields of communications, broadcast, FDM, PCM, SSB, sonar, satellite communications, navigation systems and fixed and mobile radio for aircraft.

Previously, the only means of making high resolution measurements in this frequency range was to programmable analysers or high frequency instruments and with facilities designed for those frequencies operating up to 1 GHz.

As with the TF2370, the TF2371 offers Marconi Instruments's unique display system which includes the electronic graticule — movable in frequency and amplitude directions to simplify the measurement of relative amplitude and frequency. A significant advantage of the display system is the digital store which may be split in two for simultaneous display of the updated signal and a stored image for before and after comparison purposes.

The flicker-free stored image will remain on the screen without fading or 'blooming', for as long as required. Analysis of the stored signal can be carried out using a bright line cursor and frequency counter to identify signal components, spurious signals, amplifier and filter bandwidths.

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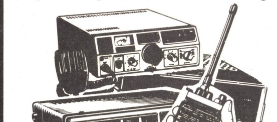

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FL-2100B 1.2kW HF linear amp	D-2546	$599.00	$529.00	$70.00!!!
FC-901 antenna coupler	D-2855	$289.00	$265.00	$24.00!!!
DC/DC converter for 101Z/901	D-2856	$75.00	$69.00	$6.00!!!
Fan for 101Z	D-2865	$39.00	$29.50	$9.50!!!
YC-500S 500MHz freq. counter	D-2892	$499.00	$475.00	$24.00!!!
FTV-250 transverter	D-2894	$339.00	$299.00	$40.00!!!
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	656 Bridge Road,	RICHMOND.	Ph 428 1614
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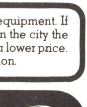

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shortwave loggings

Time to hear the Latin rhythms!

Right now in east Australia is the best time of year to hear stations in Central and South America.

If you tune down on any evening to either the 49 or the 60 metre bands you will be able to hear many of the shortwave outlets located in places as diverse as Guatemala and Argentina. Almost all these stations are broadcasting for their local audience.

Listening in to these local Latin broadcasters can be very interesting, with their lively announcers, jingles, and the many musical styles, from romantic ballads and Andean folk flutes right through to old US or English rock-and-roll.

Many of the radio stations of Latin America will be pleased to know that distant locations like Australia are picking up their signal. These stations will often reply to a DXer's reception report with a specially-designed card or perhaps a personal letter to the DXer, verifying his reception of the station.

An added touch of colour in Latin American DXing is the practice of some stations in sending pennants to listeners along with a QSL. These pennants are essentially a way of advertising the radio station and so are usually brightly coloured with striking designs.

The major stumbling block in the way of most DXers which prevents them from participating in DXing Latin American stations is the language barrier. With the major exception of Portuguese-speaking Brazil, most of Latin America is Spanish speaking. Most stations in Latin America like to receive reception reports in Spanish as it is unlikely that there will be any station personnel who are fluent in English.

There are many DXers both in Australia and around the world who have extensive collections of QSLs from Latin American radio stations, yet who could not carry on even a simple conversation in the Spanish language.

Most experienced DXers will tell you that it is only really necessary to get to know a few key words of Spanish in order to identify and report on your reception.

Station identification announcements may take several forms:

La Voz de . . .	The Voice of . . .
Esta es Radio . . .	This is Radio . . .
Aqui . . .	Here is . . .
Transmite . . .	Transmitting . . .

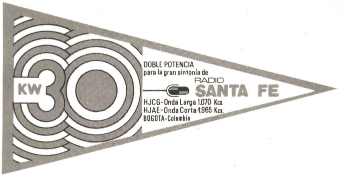
Although "radio" is the most common form of station slogan, not all stations commence identifications with this word. Others start their titles with "ondas" which means "waves". Still others may use the term "ecos" which translates to "echoes".

The term "ondas" also is useful to know for gaining details of the programmes you hear. A station, especially at sign-on or sign-off, will mention their operating frequencies. They will mention their medium-wave frequency, beginning with the words "onda media" or "onda larga", which both essentially translate as medium-wave, and then give their shortwave frequency or frequencies, beginning with the words "onda corta".

Most stations give the frequency in kiloHertz or "kilociclos", plus the metre band corresponding to their wavelength. For a station on 60 metres, this would be "banda de sesenta metros", or sometimes just as "banda tropical", as the shortwave bands below 49 metres are usually called the tropical bands.

These few Spanish phrases should assist you in identifying the many latin American stations you can hear on shortwave. If you would like to try your hand at reporting reception to one of the stations you hear, then a very good aid is the ARDXC's newly-published "Spanish Report Guide."

The "Guide" contains phrases you can use to construct a letter in Spanish to a radio station, plus a comprehensive glossary of terms needed to compile a report in Spanish. The ARDXC's "Spanish Report Guide" is available for $2 from the address in this column.



Zimbabwe broadcasting re-organised

With independence on 18 April, the national broadcast station in Salisbury has been renamed the Zimbabwe Broadcasting Corporation and this identification is now used on the air together with the abbreviated form, ZBC.

The ZBC continues to use the familiar shortwave frequencies from the transmitters located at Gwelo, with 3396 on air with English to 2200 daily except Sundays when sign-off is at 2102.

Meanwhile, 3306 carries various national languages to 2015 daily except on Saturdays and Fridays when transmission continues until 2200.

A re-organisation of broadcasting is now taking place in Zimbabwe, with a greater emphasis expected to be placed on broadcasts in national African languages such as Shona and Ndebele.

Indonesian College

Probably one of the few tertiary colleges in the world to have an international voice on the shortwave bands is Radio Institut Teknologi located in Bandung in West Java.

Radio Institut Teknologi may be heard currently on 6012 in the 49 metre band with signals best during our evenings from about 1100.

There may be some interference from a Venezuelan station on 6010, and from Radio Korea in Seoul on 6015.

The Bandung station plays local as well as US and European pop music tunes, with announcements generally being in Indonesian.

The power of Radio Institut Teknologi's transmitter on 6012 is rated at 1.8 kilowatts.

Iran shifts

The external services of the Voice of the Islamic Republic of Iran has recently moved to the new frequency of 9033, replacing 9022.

This alteration may be a transmitter fault but currently 9033 may be heard carrying English at 1930-2030, preceeded by French at 1900, German at 1830 and Turkish at 1730.

NOTE! All times are given in Greenwich Mean Time (GMT). To convert to Australian Eastern Standard Time, add 10 hours (11 hours for Daylight Saving Time). To convert to Central Time, add 9.5 hours and for Western Time add 8 hours. All frequencies are in kHz.

Shortwave Loggings is compiled by Peter Bunn on behalf of the Australian Radio DX Club (ARDXC). Further information on DXing or the activities of ARDXC may be obtained from either PO Box 67, Highett Vic 3190, or from PO Box 79, Narrabeen NSW 2101, for a 30c stamp.

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2.75.D21 21 dB gain 2. Outlets.
16-100 16 dB gain 1. Outlet
27-100 27 dB gain 1. Outlet
42-100 42 dB gain 1. Outlet
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PREDICTIONS

JULY 1980

Covering 3 to 40 MHz, these predictions show the times radio contact is possible between the areas designated beneath each graph, as well as the possible 'mode' and reliability. Vertical columns indicate time — commencing at 0000 UT on the left, to 2300 UT at right. For reliable predictions follow the times and frequencies indicated by the F character.

Complete information on using these predictions can be obtained by sending a stamped, self-addressed envelope to:-

ETI — Predictions
3rd floor 15 Boundary St
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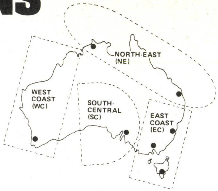


These GRAFEX style computer generated predictions are provided courtesy of the Australian Ionospheric Prediction Service.

KEY TO SYMBOLS

A blank area means no normal propagation is possible.

% . . . . path open 50 - 90% of days in month.

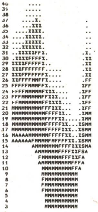
F . . . . path open at least 90% of days in month.

B . . . . propagation possible via E and F layers over 90% of days. Overrides 'F'.

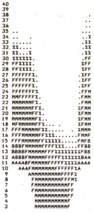
M . . . . . propagation possible by both 1st and 2nd F-layer modes. Expect strong fading.

S . . propagation possible by 2nd mode (also 3rd and mixed E and F modes). Expect strong fading, weak signals.

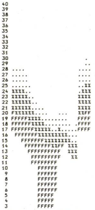
A . . . . High absorption indicated. Expect weak signals.



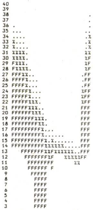
East Coast to Japan
(Also serves N.E. and S.C.)



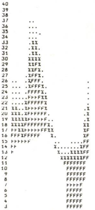
East Coast to South Pacific



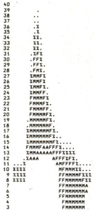
East Coast to North America
(Also serves N.E. and S.C.)



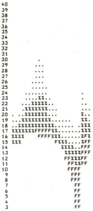
East Coast to South America
(Also serves S.C.)



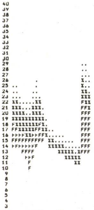
East Coast to North Africa
(Also serves S.C.)



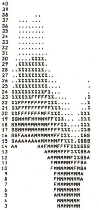
East Coast to South Africa
(Also serves S.C.)



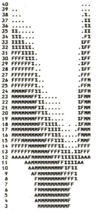
East Coast to Europe
(Short Path)



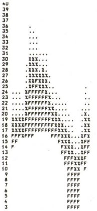
E.C. and S.C. to Europe
(Long Path)



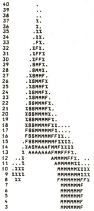
East Coast and S.C. to Persia



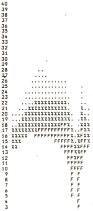
North East to South Pacific
(Also serves S.E.)



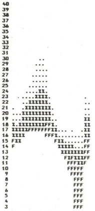
North East to North Africa



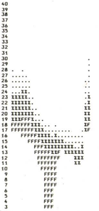
North East to South Africa



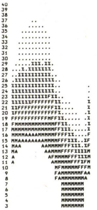
North East to Europe
(Short Path)



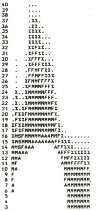
S. Central & W.C. to Europe
(Short Path)



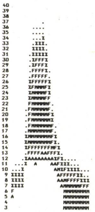
West Coast to North America



West Coast to Japan



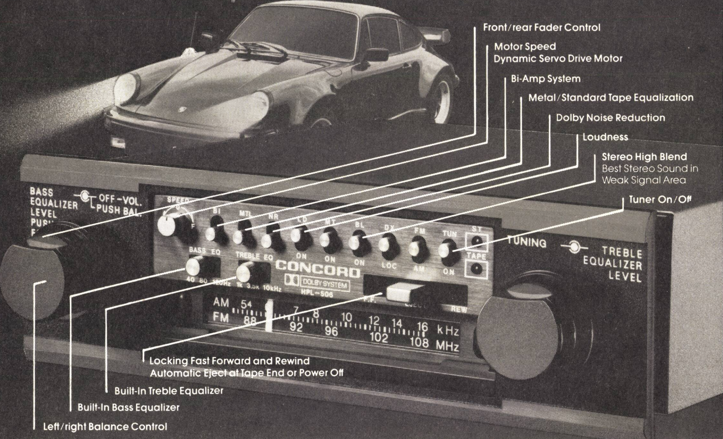
West Coast to North Africa



West Coast to South Africa

CONCORD®

drives auto high fidelity to new limits.



Front/rear Fader Control

Motor Speed
Dynamic Servo Drive Motor

Bi-Amp System

Metal/Standard Tape Equalization

Dolby Noise Reduction

Loudness

Stereo High Blend
Best Stereo Sound in Weak Signal Area

Tuner On/Off

Locking Fast Forward and Rewind
Automatic Eject at Tape End or Power Off

Built-In Treble Equalizer

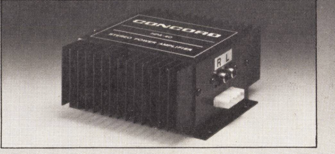
Built-In Bass Equalizer

Left/right Balance Control

Superior equipment for superior performance.

Concord Hi-Fi Series is the choice of the dedicated "sound buff" who demands superior performance— ● Dolby Noise Reduction ● Sendust Alloy Head ● Metal Tape compatability ● Hi-Fidelity Power ● Fader Control ● Din Size (dashboard installation) ● Bi-Amp Facility ● Superior FM Sensitivity ● Low Wow, Flutter ● Separate Bass and Treble Control.

The Concord range of auto high fidelity equipment includes hi-fi car stereo amplifier, 5-band graphic equaliser and a range of speakers.



SPECIFICATIONS
● High fidelity power: 25 watts RMS per channel into 2 ohms (18 watts into 4 ohms) both channels driven 20-20000 Hz at less than 0.3% T.H.D. ● Tape signal-to-noise ratio (Dolby on) 56 dB ● Tape frequency response—standard tape 30-15000 Hz ± 2 dB—metal tape 30-20000 Hz ± 2 dB ● Tape Wow and Flutter—0.08% WRMS ● FM tuner sensitivity at 30 dB S/N—1.0 Microvolt (11.2 dBf) ● FM S/N ratio—68 dB ● AM tuner sensitivity—11 microvolts ● AM S/N ratio—50 dB

For further information write to PHODIS PTY. LTD.
5 Campbell Street, ARTARMON 2064. (02) 439 8900.

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CONCORD®

CONCORD is distributed and serviced in Australia
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BBP-7

sound

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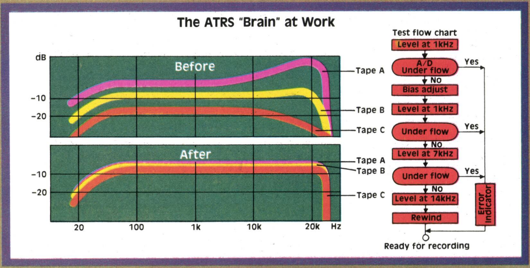
REVIEWS: ● KENWOOD KA701 AMP 136
● YAMAHA NS344 SPEAKERS 144
● WHARFEDALE 4-WAY SPEAKERS 150

The brain.

Hitachi puts it in charge of sensitivity, bias and EQ.



ATRS

(Automatic Tape Response System)

D-5500

The ATRS brain is a sophisticated microcomputer that's built into the Hitachi D-5500 Cassette Deck. Because there are hundreds of different tapes on the market, ATRS was designed to match bias and EQ settings to the precise characteristics of each one you use.

Press the test button while in record and in 20 seconds ATRS carries out six calibration functions. It also has three individual memories for the test results of the three tapes you use most frequently.

The D-5500 adds to that little miracle of technology a few more Hitachi firsts. Like a full IC logic detachable control block that doubles as a wireless infrared remote unit. A direct-drive Unitorque™ motor (0.028% WRMS wow and flutter). And a close-gap R&P three-head system.

The Hitachi D-5500 Cassette Deck with ATRS. It never stops thinking about your music.

HITACHI

Hitachi Sales Australia Pty. Ltd., 153 Keys Road, Moorabbin, Victoria 3189 Tel: 95 8722

New speaker drivers

Hot news for this month is the new range of Danish "Dynaudio" high performance speaker drivers just released here through Dynaudio (Aust) Pty Ltd in Melbourne.

What with the wide range of 'super' discs and direct-cut recordings, not to mention the recent rash of 'digital' discs, the performance demands on the sound reproduction chain have increased, particularly with speakers.

The Dynaudio drivers feature wide dynamic range, low harmonic and transient distortion and high power handling capacity.

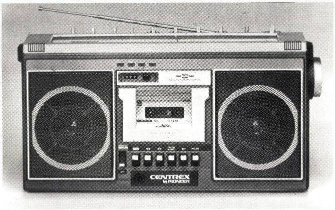
These new drivers have cast magnesium alloy frames and the cone has a shallow, curved profile designed for optimum phase and transient linearity. The mid-range and treble drivers use ferro-fluid in the magnet gap for improved performance and all drivers use "hexacoil wire" for the voice coil windings.

A range of high quality loudspeaker systems has been designed for Australian applications. More details from Dynaudio (Aust) Pty Ltd at 654 Glenferrie Rd, Hawthorn Vic 3122. (03) 818-2872, 818-8637.

'Super' portables

Pioneer has forged ahead in the portable music market with their recently-released SK-6 and the SK-7 stereo radio cassettes.

Each has a Pioneer multi-mode deck system similar to the more expensive three-in-ones. Separate repeat functions have also been included and optional add-ons are available in the form of bookshelf speakers and ten watt per channel amplifiers.



Protect your records

Static build-up on a record can attract dust particles to the record surface, possibly contributing to surface damage, as well as affecting stylus pressure and tracking and introducing distortion.

"Anti-static", lubricants can be effective in reducing surface noise due to dust particles attracted by static, reduce friction on the stylus and remove the other debilitating effects of static on discs.

'Discprotect', an anti-static record preservative, was recently released in Australia through Goldring Audio.

The product won the coveted Japanese Grand Prix Gold Award for 'stereo art' in 1978 and the US Audio-Video HiFi Grand Prix Award in 1979.

The makers claim Discprotec eliminates static build-up for 100 plays or more of a disc, reduces record and stylus wear, protects discs from environmental attack and loss of plasticizers and does not contribute to surface noise or increase harmonic distortion.

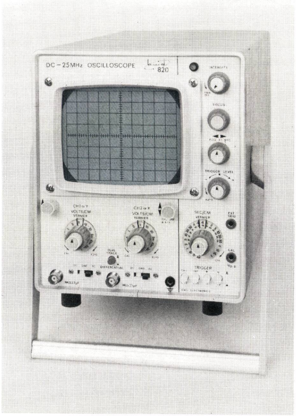
Full details from Goldring Audio Industries, 5th floor 69 Clarence St, Sydney 2000. Phone (02) 290-1455, Telex 24905.

Precision Instruments   Made to Measure

. . the versatile

BWD 820
DC to 25 MHz Dual Trace or Differential Oscilloscope

- NEW contemporary design
- Precision performance
- Extended operating range
- Surprisingly modest price



- **DC-25 MHz** Bandwidth.
- **<13nSec Rise Time.**
- **2mV to 20V/cm** Sensitivity.
- Dual Trace or **Differential** Operation.
- **40nSec** to 5 Sec/cm Time Base Range.
- 2 Hz to **40 MHz Triggering Range.**
- DC Coupled **X-Y-Z** Operation.
- **4 KV EHT.** Mesh PDA CRT.
- **Direct reading** in-line attenuator and time base dials with continuously variable vernier controls.
- **Stabilised power supplies** throughout.

MANY ADDITIONAL FACILITIES

The vernier controls of the BWD 820 have locking detents in the calibrated position. Calibration accuracy is within 3%, from 5° to 45°C, and over a supply voltage range of 200-270V (or 100-135V) without additional range changing.

Operation is simplified by automatic changeover from chopped to alternate operation and frame to frame line selection in the video mode.

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Ideal for use on audio, video or digital circuits, in education, servicing or industrial applications.

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W.A.	Warburton Franki (Perth). Ph: 277 7000
TAS.	Associated Agencies Pty. Ltd., Hobart. Ph: 23 1843 Instrep Pty. Ltd., Hobart. Ph: 34 3194
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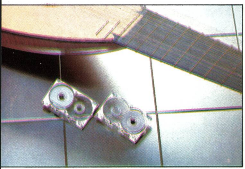
NC820

Sansui

Only hi-fi, everything hi-fi.

The warmth of metal.



New metal tape promises purer music. But it depends on the tape deck if that promise becomes real.

Pure iron particles explain the superior performance of metal tape. Greatly improved dynamic range, far higher S/N, wider frequency response, and radically reduced distortion mean purer music.

Sansui's new SC-3330 brings that purer music to life. All the subtle nuances of recorded sound, from the metallic overtones of a piccolo to the warm resonance of an old lute are breathtakingly reproduced.

Particularly critical for smooth Debussy or Fleetwood Mac on metal is Sansui's exclusive FH head (FeAlSi alloy head). Advantages include extra-long life, ultra-high MFD (maximum flux density) to prevent high bias saturation, and a special hyperbolic head. Sansui developed that head shape to minimize the contour effect for a wide-range *Pelléas* or *Tusk*.

Keep in mind, too, that our special head formulation isn't superficial — it's throughout the head, from surface to core. And 200% more erase current means our erase head does a clean job indeed.

Front-loading, two DC motors and feather-touch controls with full logic for a host of automatic functions are other refinements. The 16 LED Bar-Graph Meter makes recording exceptionally accurate. Wow & flutter: 0.04%. Frequency response: 20 — 18kHz (metal). Erasure factor: 70dB. Special features: too many to list. Performance: brilliant.

Sansui's SC-3330: the new deck everyone feels passionate about!

SANSUI

SC-3330

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VANFI (AUST.) PTY. LTD.
297, City Road, South Melbourne, Victoria 3205, Australia Tel: 699-5473
283 Alfred Street, North Sydney, N.S.W. 2060, Australia Tel: 929-0293

Toshiba System 10 micro components

Following introduction of their top-of-the-line 15 series micro components early in 1979, Toshiba (Australia) P/L released a less sophisticated series late last year.

Designated the System 10, the components in the series are: an integrated stereo amp — the SB-A10 — with 20 watts per channel output at less than 0.1% THD quoted; • an FM/AM stereo tuner — the ST-T10 — with automatic frequency control; • a stereo cassette deck — the PC-D10 — with metal tape facility, Dolby nr and auto repeat.

See the system at any Toshiba dealer's showrooms.

Improve car cassette sound

Cassettes played in the car never seem to sound quite as good as when played in the stereo at home.

Road noise and the limitations of some car stereo cassette heads account for this.

BASF are offering a new Ferrochrom cassette which they claim compensates for these factors.

The secret lies in the two different oxide materials which are coated on the tape surface, say BASF. The bottom layer is a relatively thick coating of fine ferric oxide which provides improved reproduction in the low and middle frequencies. On top of this is a microscopically thin layer of chromium dioxide which enhances the higher frequencies.

Because of the "double-layer" construction, the cassettes have a wide range of bias and equalisation tolerance, according to BASF.

This means a recording made at home using the BASF Ferrochrom, on normal bias, 70 us equalisation position will provide improved sound reproduction when the cassette's replayed in the car. The boost in the upper mid-range frequency offsets the crop-off between 8 kHz and 11 kHz in most car stereos.

The new cassettes perform exceptionally well on all home stereo equipment, say BASF.

For further information, contact Mr N. Price, BASF Australia Ltd, 55 Flemington Road, North Melbourne Vic 3051. (03) 329-9555.

Stereo receiver breaks $200 barrier

Pioneer claim to have broken the $200 price barrier with their SX-408 FM/AM stereo receiver.

First seen here as part of their popular Formula 4000 System, the SX-408 has now been released as a separate component to sell at a recommended retail price of $199.

Instead of adding a tuner to an existing amp, Pioneer see the SX-408 as a competitively-priced replacement item. An amplifier can be updated while obtaining a tuner with the added benefit of little increase in overall size.

The receiver is rated at 16 watts RMS per channel output with total harmonic distortion not exceeding 0.3%.

The simple front panel features separate bass and treble controls, loudness switch, tuning meter and a comprehensive function selector.

The SX-408 is covered by a three-year warranty and is available at all Pioneer outlets.

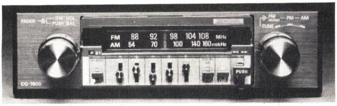
New mid-range speaker

The Peerless KA 20 50 mm domed mid-range speaker is designed specifically for use in top class multi-way speaker systems.

It has a fundamental resonance of 270 Hz which is well damped and results in a frequency range of 600 Hz to 6 kHz, according to Peerless. The sound pressure level (SPL) at 1 m is 96 dB at four watts and maximum rated power is 100 watts with a 12 dB/octave crossover at 600 Hz, according to the specs.

The special construction of the mounting plate, with the dome placed in a cylindrical aperture, not only provides protection against damage but also provides an acoustic lens to enhance its excellent performance, say Peerless.

Detailed information and stocks of the units are available from the sole Australian Agent: G.R.D. Group Pty Ltd, 698 Bruke Rd, Camberwell 3124 Vic. (03) 82-1256.



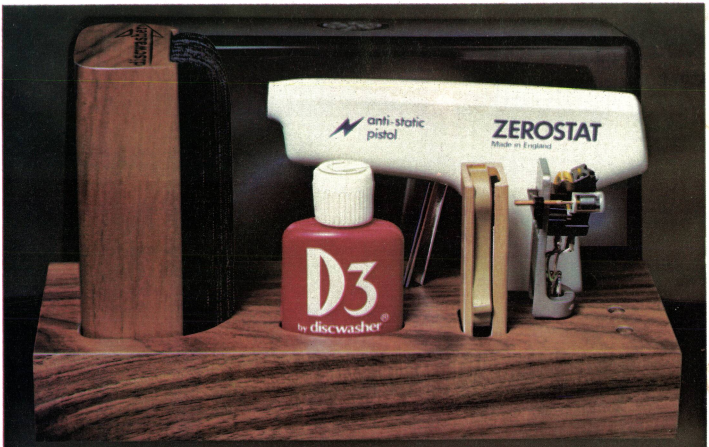
New National car stereo has graphic equaliser and Dolby

National Panasonic's Model CQ-7600 AM/FM car stereo radio tuner and cassette stereo system features a graphic equaliser and Dolby.

The five-band graphic equaliser has a quoted range of 12 dB on each frequency, Dolby noise reduction with selector switch, auto replay on cassette, bi-amplification and stereo and tape direction indicator lights.

It is designed to operate with a National Panasonic solid state four-speaker main amplifier, Model CJ-3000. The recommended speakers for the system are, front, two Model EAB-903N flush mounted dual-cone types and, rear, two Model EAB-752N high-power two-way coaxial speakers.

A typical set-up as mentioned would give results approaching in-home hi-fi reproduction in your car, say National. Recommended retail price is $730 for the complete system, plus installation charges.



Record Ecology in DiscKit form

— you'll Save more than money

DiscKit is a crafted walnut tray and dustcover that saves you 20% with the Discwasher products in the kit. ($55 versus $69 separately) DiscKit includes: 1) The Discwasher System Record Cleaner with D3 Fluid, 2) the Zerostat anti-static pistol and test light, and 3) the SC-1 Stylus Cleaner.

But you'll save more than money. You'll save your records from imbedded micro-dust, your cartridge stylus from abrasion and your ears from a lot of static.
It's your choice, disposable records or Discwasher. (Walnut tray and dust cover are available separately as the Discorganizer, $15)

Cartridge and Disc Traker (pictured) not included in Kit, ask your nearest dealer for details.

Now includes free,
DC1 pad maintenance brush.

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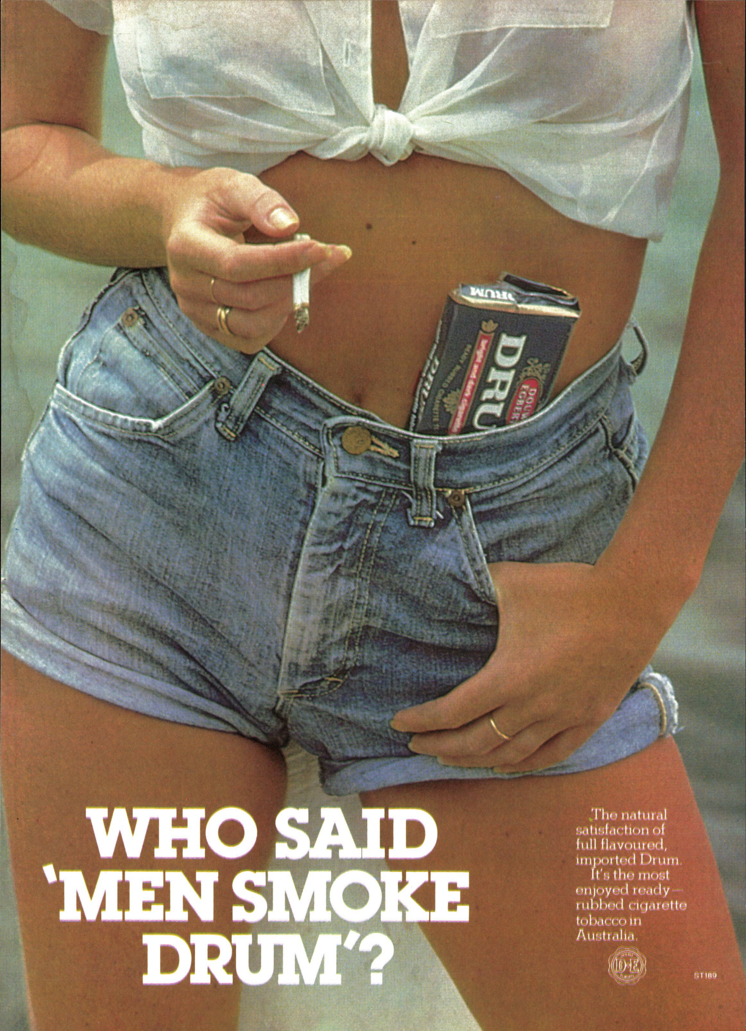

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satisfaction of
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imported Drum.
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enjoyed ready—
rubbed cigarette
tobacco in
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ST189

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2 Two body depths.

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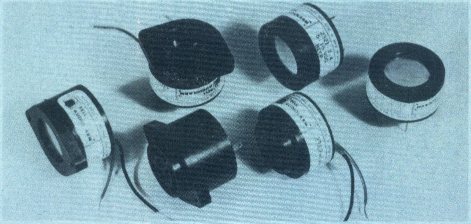
Operating voltage ranges are 3-16V, 5-16V and 5-30V.

Terminals are either colour coded wires, quick connect or printed circuit, while mounting is simplified to the extreme with permanent, self adhesive washers on some models.

New Multiform AudioLarm backed by C&K reputation . . . consider the advantages.



C&K COMPONENTS

C&K Electronics (Aust.) Pty Limited

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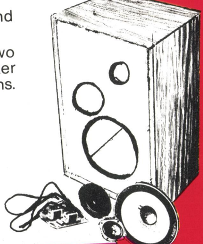

Peterson SPEAKER LABORATORIES Pty Ltd

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Music and acoustics

— an interpretation, by John Gardner

An orchestra playing in the Sydney Opera House will sound quite different when playing the same piece in Adelaide's Festival Hall and different again when playing out of doors. Some influences are obvious, some subtle. John Gardner discusses why.

IF YOU were to creep into the Sydney Opera House in the dead of night, stand on the podium and shout "Eureka" at the top of your voice, you might well end up in a mental institution. If you did the same thing at Woomera you could be investigated as a security hazard. However, before they took you away, you might have a chance to observe that the same word shouted in the two locations sounds entirely different in character.

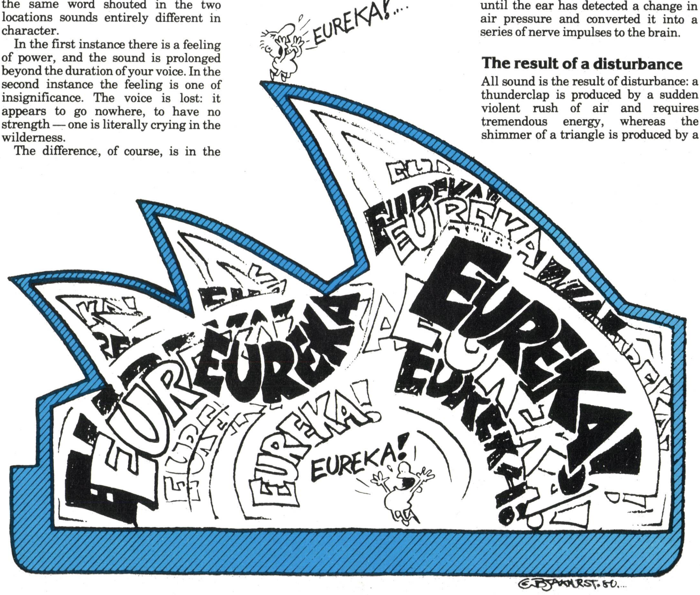
In the first instance there is a feeling of power, and the sound is prolonged beyond the duration of your voice. In the second instance the feeling is one of insignificance. The voice is lost: it appears to go nowhere, to have no strength — one is literally crying in the wilderness.

The difference, of course, is in the acoustic environment: and if we go to another extreme and sing in the bath, the voice immediately becomes more vibrant and we wonder why we were not offered a recording contract years ago. What applies to the voice applies, to a greater or lesser extent, to music: so what significance has the acoustic environment for the music lover? There are several answers to that, depending on whether one is a performer, concert-goer or record enthusiast.

Before we consider these we need to know something about the nature and propagation of sound waves. It is also important to realise from the outset that a sound as such does not exist — not until the ear has detected a change in air pressure and converted it into a series of nerve impulses to the brain.

The result of a disturbance

All sound is the result of disturbance: a thunderclap is produced by a sudden violent rush of air and requires tremendous energy, whereas the shimmer of a triangle is produced by a ▶


EUREKA!...
EUREKA!

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The Casseiver combines a front-loading Dolby* cassette deck, with twin LED displays and soft-eject mechanism; a built-in amplifier delivering 15 watts/channel RMS; a sensitive 4-band AM/FM/SW1/SW2 stereo tuner and a full-range speaker system with passive cone radiators. And with provision to add on other components, such as a turntable, the Sony Casseiver is truly a system like no other.
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The PS-212A turntable (pictured) is an optional extra.
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SONY
AUDIO

AP3412

gentle vibration. If a simple continuous tone (say from a tuning fork) were picked up by a microphone and the electrical output displayed on an oscilloscope, the trace would appear as in the upper section of Figure 1.

This is really a graph of voltage (vertical) against time (horizontal). The signal produced follows a symmetrical path, rising to a maximum value, and so on.

The distance between successive peaks is a wavelength, and the pitch (or frequency) of a note is determined by the number of wavelengths passing a given point in one second. That is, if 440 wavelengths pass this point in one second, the sound has a frequency of 440 cycles per second, usually known as Hertz (Hz). If the top trace of Figure 1. represents Middle A (440 Hz) with a wavelength in air of 0.75 metres, then the bottom trace is one octave higher, that is, the frequency is doubled to 880 Hz and the wavelength reduced to 0.375 metres.

This representation is a convenient way of expressing sound in visual terms, and it is significant that almost all descriptions of sound quality or texture are analogies of sight and touch. Sound is warm, muddy, coloured, clinical, neutral, clean, fuzzy, plummy, hard, dark brown, open, cold, lush, edgy, ragged, spiky, and so on. This is probably because we cannot easily convey to one another what we hear except by reference to other experiences we have in common.

Sound travels

We must now consider how sound travels from A to B. Figure 1 showed the rise and fall of voltage (or air pressure) with time; it did not show how the sound wave moves from point to point through air. This is better demonstrated with a child's toy — the Slinky Spring. If one end is held whilst the other is moved to and fro, a series of ripples appears to move along the spring. What actually happens is that the individual turns of the spiral move to and fro about a mean position and give the illusion of continuous onward movement. This is an almost exact analogy of sound wave propagation.

Imagine a loudspeaker cone vibrating, or the skin of a bass drum. In either case a membrane is oscillating about a central position and alternately moving out into the free air and then back into the body of the instrument. Each excursion into the air causes marginal compression — or a localised increase in pressure. Each incursion causes a marginal reduction of pressure, known as a rarefaction.

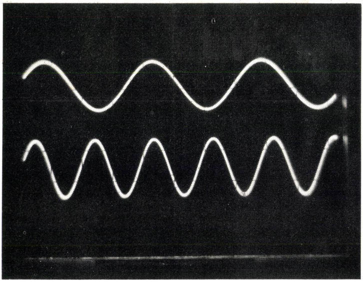


Figure 1. **The rise and fall of a voltage with time — a wave (here, a sine wave).**

So the pulsating drum or loudspeaker is rhythmically disturbing the surrounding air and, as with the Slinky, the disturbance has a 'knock-on' effect, carrying the sound energy away from the source, although any given particle of air is only marginally affected. If it were otherwise, a performance of the "Ride of the Valkyries" would subject you to a gale-force blast and make for rather uncomfortable listening!

We are now ready to discuss what happens in the concert hall. It is well known that musicians are happier and play better in some locations than others. Equally, the concert-goer has preferred venues for particular performances; but the musician and the listener will not necessarily agree what constitutes a good location.

Musical environments

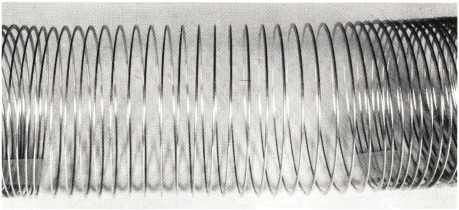
As an extreme example of this we can cite an outdoor symphony concert which, on a beautiful day in a picturesque spot, may seem superb to the listener. In fact he will hear a very unbalanced sound, but his judgement will be impaired by the visual stimuli. The musician will be less enamoured of the location: he will find it hard to judge his touch and his loudness, and he will have difficulty playing in unison with his colleagues. To assist the musicians in these circumstances, the bandstand or concert platform is composed of hard rostra and there is usually a shell of some sort behind and to the sides of the players so that some of their sound is reflected back and they can hear what they are playing.

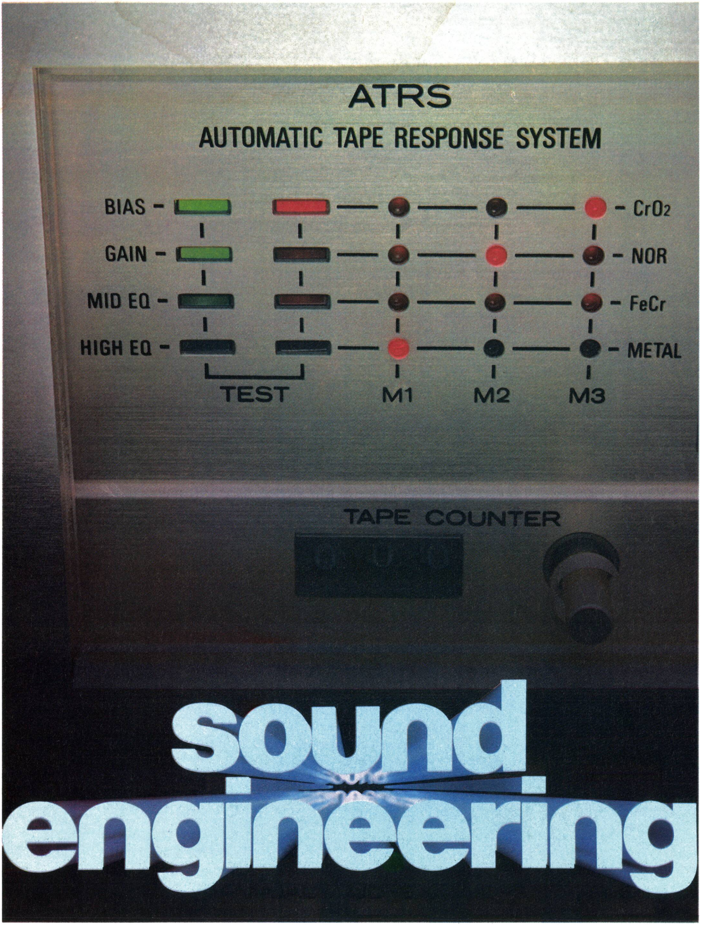
What a musician requires, therefore, is an environment that gives something back: if he is playing in an unsympathetic hall he might just as well be outside.

The difference between a good hall and a poor one is not very great: but that small difference depends on subtle and elusive factors that are not easy to define. There are known formulae to determine how 'live' or 'dead' a room will sound, and the strength of various reflections can be predicted. What is

to page 131. ▶

The Slinky Coil, or Tumblebug, can illustrate how sound waves travel, as discussed here.





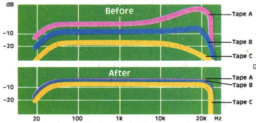
sound engineering

HITACHI

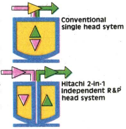
Hitachi's ATRS* and R&P head

This built-in microcomputer and combination head are the D-5500M Cassette Deck's little miracles.

Hitachi's D-5500M is without a doubt the most advanced cassette deck available. It features a sophisticated microcomputer that makes sure you get the best possible performance with any type of tape. Just load the D-5500M with the tape of your choice, press the TEST button, and 20 seconds later the deck is precisely calibrated to give you unsurpassed sound quality. Our revolutionary R & P combination record and playback head provides the exceptional reproduction accuracy to make this system possible. Of course, you also get the super sound benefits of the high-performance metal tapes. The microcomputer even has a memory so you can store the calibration data for three of the tapes you use most. The data can then be recalled at any time by a simple push of a button.



Before/After comparison of ATRS brain at work


Conventional single head sytem
Hitachi 2-in-1 independent R&P head system

Graphic illustrations are reconstructed from Hitachi Toyokawa audio laboratory data.

Other little technological miracles that make the D-5500M the cassette deck leader are a logic transport control unit that can be removed from the deck's panel to function as a wireless remote control, and a Hitachi Unitorque direct drive capstan motor that keeps wow and flutter below 0.028% (WRMS).

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WHY NOT JUST WRAP?

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JW-1-W	WHITE WIRE
JW-1-Y	YELLOW WIRE
JW-1-R	RED WIRE

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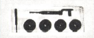
R-JW-W	WHITE WIRE	50 ft. Roll
R-JW-Y	YELLOW WIRE	50 ft. Roll
R-JW-R	RED WIRE	50 ft. Roll

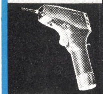
UNWRAP TOOL FOR JUST WRAP

JUW-1	UNWRAPPING TOOL



JUST WRAP KIT

JWK-6	JUST WRAP KIT



"HOBBY" WIRE WRAPPING TOOL BATTERY POWERED

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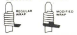
BT-30	BIT FOR AWG 30
BT-2628	BIT FOR AWG 26-28

HOBBY WRAP TOOLS



WSU-30	REGULAR WRAP
WSU-30M	MODIFIED WRAP

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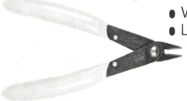

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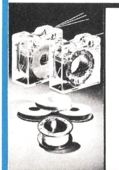

TRI-COLOR DISPENSER

WD-30-TRI	TRI-COLOR DISPENSER

R-30-TRI	REPLACEMENT ROLLS

WIRE DISPENSER

WD-30-B	BLUE WIRE
WD-30-Y	YELLOW WIRE
WD-30-W	WHITE WIRE
WD-30-R	RED WIRE

DISPENSER REPLACEMENT ROLLS

R-30B-0050	30-AWG BLUE 50 FT. ROLL
R-30Y-0050	30-AWG YELLOW 50 FT. ROLL
R-30W-0050	30-AWG WHITE 50 FT. ROLL
R-30R-0050	30-AWG RED 50 FT. ROLL

®KYNAR-PENNWALT

HOOK-UP WIRE

HK-18	18 AWG	25 FT.	SOLID CONDUCTOR
HK-20	20 AWG	25 FT.	SOLID CONDUCTOR
HK-22	22 AWG	50 FT.	SOLID CONDUCTOR
HK-24	24 AWG	50 FT.	SOLID CONDUCTOR
HK-26	26 AWG	50 FT.	SOLID CONDUCTOR
SHK-18	18 AWG	25 FT.	STRANDED CONDUCTOR
SHK-20	20 AWG	25 FT	STRANDED CONDUCTOR
SHK-22	22 AWG	50 FT.	STRANDED CONDUCTOR
SHK-24	24 AWG	50 FT.	STRANDED CONDUCTOR
SHK-26	26 AWG	50 FT.	STRANDED CONDUCTOR

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- Automatic pulse stretching to 50 Msec.
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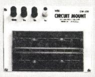
- No switches/no calibration

PRB-1	DIGITAL LOGIC PROBE

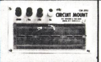


PROTOTYPE BOARD CM-100

TERMINALS: 1,020 TEST POINTS. 188 separate 5 point terminals, plus 2 horizontal bus lines of 40 common test points each.

SIZE: 6½" Wide, 5" Long.

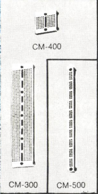
CM-100	MODULAR PROTOTYPE BOARD



PROTOTYPE BOARD CM-200

TERMINALS: 630 TEST POINTS. 94 separate 5 point terminals, plus 4 bus lines of 40 common test points each. SIZE: 6" Wide, 3½" Long.

CM-200	MODULAR PROTOTYPE BOARD



PROTOTYPE BOARD CM-300, CM-400

CM-300 and CM-400 have two separated rows of five interconnected contacts each. Each pin of a DIP inserted in the strip will have four additional tie-points per pin to insert connecting wires. They accept leads and components up to .032 in. diameter. Interconnections are readily made with RW-50 Jumper Wire. All contact sockets are on a .100 in. square grid (1¾ in. wide).

CM-300	MODULAR PROTOTYPE BOARD
CM-400	MODULAR PROTOTYPE BOARD

MODULAR BUS STRIP

CM-500 is a bus strip to be used in conjunction with CM-300 and CM-400 for distribution of power and common signed lines. Two separate rows of common terminals, grouped into clusters of five. All contact sockets are on a .100 in. square grid.

CM-500	MODULAR BUS STRIP

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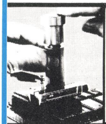
Narrow profile. Pin straightener built into tool. Automatic ejector.

INS-1416	14-16 PIN DIP/IC INSERTER

MOS, CMOS-SAFE

GROUND STRAP NOT INCLUDED

MOS-1416	14-16 PIN, MOS CMOS SAFE INSERTER
MOS-2428	24-28 PIN, MOS CMOS SAFE INSERTER



36-40 PIN CMOS-SAFE IC INSERTION TOOL

Aligns bent out pins. Includes terminal lug for attachment of ground strap.

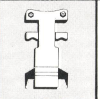
GROUND STRAP NOT INCLUDED

MOS-40	36-40 PIN CMOS SAFE INSERTION TOOL

DIP IC EXTRACTOR TOOL

Extracts all LSI, MSI and SSI devices of from 8 to 24 pins.

EX-1	EXTRACTOR TOOL



24-40 CMOS-SAFE EXTRACTOR TOOL

Removes 24-40 pin IC's, .600" centers. C-MOS safe. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

EX-2	CMOS SAFE EXTRACTOR TOOL

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less easy to predict is whether in practice a hall will be acoustically satisfactory, despite any amount of theoretical calculation.

The BBC has tried to overcome this by making models of proposed new studios in order to investigate their acoustic properties. One of the problems with a model is that if it is scaled down by, say, a factor of ten, then the music must be scaled up by a factor of ten in order to maintain the relationship between room demensions and the sound wavelengths.

Wavelengths

We mentioned wavelengths earlier and it is worth examining them further because they have a direct bearing on the reflection and absorption of sound at various frequencies. Compared with radio and light waves, the dimensions of sound waves are large, especially at low frequencies. For example, a 50 Hz note has a wavelength of 3.4 metres, for 1000 Hz it is 0.3 metres, and for 10 000 Hz it is 0.03 metres.

This means that obstacles such as pillars, seats, people, drapes, panelling and even small rooms are of comparable dimensions with some instrumental sounds. Where an obstruction is large compared with the wavelength of a sound, that sound tends to be reflected, particularly from hard surfaces. A soft surface tends to absorb part of the energy from the wave and so weaken the reflection.

When an obstruction is small in comparison with a sound wavelength, the sound will go around it as though there was nothing in the way. It can be seen, then, that to modify the acoustic character of a studio or hall, low frequencies require large structures, whereas the higher frequencies can be treated selectively with various types of absorbent material.

The most efficient way of absorbing sound is to release it unobstructed into the fresh air. But, as we have seen, fresh air does not make a good playing environment, so we have to create an artificial acoustic that is neither too like a cavern, nor too like the great outdoors.

Of course, some halls exist that are naturally suited to the playing of live music, such as the Sofiensal, Vienna, or St John's, Smith Square in London. Others are specifically treated to make them so.

If an echoey room is filled with a sufficient quantity of the right type of sound absorbing material it becomes 'dead' with a total absorption and therefore no reflection. This is the anechoic chamber, or dead room, used in the development and testing of microphones and loudspeakers. It is uncanny and unnatural in a dead room and the heart seems to beat with sinister power. It is like being in the world of Poe.

It is apparent that by absorbing the right amount of sound at the right frequencies, by controlling reflections so that the orchestral sound is full, but not confused by multiple echoes, a satisfactory acoustic can be created. In order to fix accurately the source of a sound, the ear must hear the direct sound fractionally before the first reflection, so the dimensions of the hall and the seating arrangements are also critical.

Hall's effects

One indication of the suitability of a hall for music is its reverberation time. If a steady tone is sounded in a room until a sound field of constant intensity is created, and then the tone is abruptly stopped, it is possible to measure the decay of sound. Reverberation Time (RT) is the time it takes for the sound intensity to fall to one millionth of its steady value. (To the sound engineer this is a drop of 60 dB).

Good acoustics are not made by slavishly following mathematical formulae, but there is a body of evidence that suggests that the RT should rise in approximate proportion to the volume of the hall. Choral and large scale orchestral works require longer RT than small ensembles. Speech requires as little as 0.3 or 0.4 seconds.

Before it was treated, the Albert Hall in London was a particularly difficult environment. The vast surface area of the dome, the many arches, alcoves, and the numerous pillars all served to disperse the sound so that such reflections as there were had a long time delay. Apart from making playing difficult, a long time delay destroys musical clarity for the listener.

Another fault of the Albert Hall, but common to many others, was that the sound quality varied from one part of the hall to another. In one place the sound would be ill-defined and ragged: elsewhere the musical texture would have the listener wondering what everyone was complaining about.

The large saucer-shaped reflective panels, which were suspended in the dome area some time ago, have considerably improved the acoustics of the hall. However, in our opinion, it remains better suited, visually and acoustically, to the LSO playing the "1812 Overture" or Beethoven's "Ninth Symphony" than to the chamber sound of Neville Marriner and the Academy. Of Queen Elizabeth Hall one might say the opposite.

Naturally a conductor is more sensitive than most to the ambience of a hall. If he is worried by late echoes, or by the deadness of the acoustic, he will be unsettled and his confidence will be affected. This feeling will be communicated to the orchestra and add to their own difficulties. In such circumstances an inspired performance is not to be expected.

Recording the sounds

The ear and the brain together form a complex computer capable of analysing, interpreting, and rejecting stimuli they receive. They can create an image which is more accurate than seems theoretically possible from the information presented. The brain sifts incoming nervous impulses from the two ears and deduces the end product. No one is quite certain how this happens.

What we do know is that neither microphones nor any of the recording equipment has a satisfactory electronic replica of this faculty to discriminate. No matter how many recording microphones are used — and frequently there are too many — they cannot analyse, they cannot reject confusing reflections: they are designed to respond accurately to all changes in air pressure. Whether that change of pressure is due to an incident sound wave, its umpteenth reflection, or to the conductor tapping his foot, the microphone will respond to it and it will be recorded.

Once recorded, most of the 'clues' that the ear used to make its accurate deductions are so scrambled on the tape that they cannot satisfactorily be recovered.

The best we can do is to produce a spatial effect so that we can mentally position the orchestra (stereo): or we can, by recording some of the sound reflections, make a crude attempt at ▶

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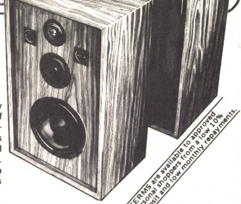
Photograph shows speakers without front grilles.



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Each of the three Playmaster speaker kits were acoustically designed by Neville Williams (MIREE), Editor-in-chief of Electronics Australia magazine. They are precision manufactured by Dick Smith so that everything just about 'falls into place'. The four side panels are pre-joined to the vinyl cladding - they simply wrap around the front baffle board. Even if you've never built anything before, you can make a pair of these magnificent speakers in about 2 hours construction time.

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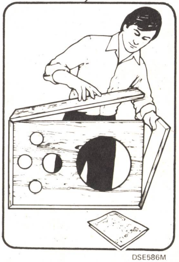
Frequency Response:	45Hz - 20kHz	35Hz - 20kHz	28Hz - 20kHz
Impedance:	8 ohms	8 ohms	8 ohms
Power Rating:	40 watts music	60 watts music	80 watts music
Total System	**$159.50**	**$248.00**	**$298.00**

Sent anywhere in Australia for only $6.00 per pair freight.



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reproducing the concert hall ambience. The latter is variously known as surround sound, quadraphony, and ambiophony, and it is by his enthusiastic pursuit of the necessary associated hardware that the fool is readily parted from his money!

External influences

However, even if the balance engineer has the good fortune to be working under ideal acoustic conditions, it is unlikely that the location will also be entirely soundproof. This is particularly true of the many halls in and around central London.

One hazard is heavy traffic, which produces a steady pulsating murmur that can occasionally break through to the microphones. Worse by far is the structure-borne vibration generated by Underground trains. This deep-throated rumble is a constant menace to recording engineers throughout the Metropolis: it marches through countless yards of recording tape like a fifth column of frustrated music critics.

Obviously the engineer would frequently prefer to use a custom built studio, acoustically tailored to his needs and also isolated from air and structure-borne noise. He then has more control over the quality of the end product and possibly has more technical facilities available.

Technical compromises

The trouble is that few recording or broadcasting organisations can afford to build a particular type of studio to meet each type of demand. As a result they tend to build general purpose studios having a rather low reverberation time. The theory is that reverberation can be added artificially if required (by the use of reverberation plates and springs, or echo rooms) but that it cannot be taken away.

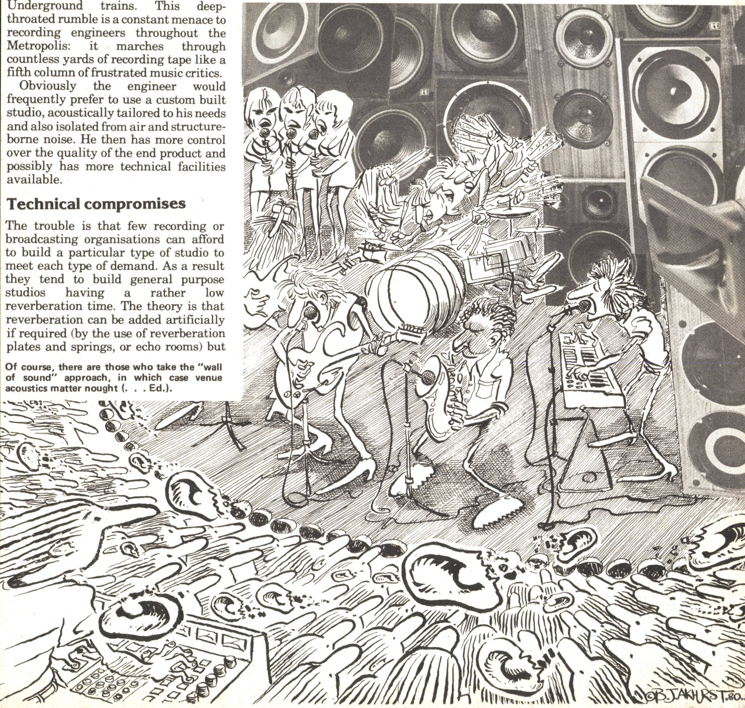
Many studios are, therefore, too dead for music to be played and recorded naturally and, as we have seen, this deadness causes problems for the players. So, although the balance engineer may get a better sound and feel more in command of the situation, the quality of the performance may suffer.

Light music and pop are exceptions to the argument and, because of the specialist techniques required, these are almost invariably recorded in a studio. Reverberation is added artificially and selectively to the different instruments. Often several reverberation plates will be used, set to different times, so that the delay, say on a vocal, will not be the same as that on the strings.

There are endless permutations of the facilities and, by using a multiple microphone array, nature is defeated and a type of sound is created on tape which would be impossible in the concert hall.

These techniques are a commendable extension of the recording art when confined to the right repertoire. Unfortunately, many a classical record producer allows himself to be hypnotised by the electronic gadgetry: he will exaggerate reality and highlight an instrument that would normally be heard only as part of an ensemble, thus distorting the composer's intention.

However, because many record enthusiasts prefer to demonstrate their hi-fi equipment than listen to music, such producers tend to enjoy a degree of success out of proportion to their taste! ●


©B.JAKHURST.80.

Of course, there are those who take the "wall of sound" approach, in which case venue acoustics matter nought (. . . Ed.).

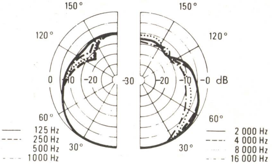
AKG acoustics

stage quality

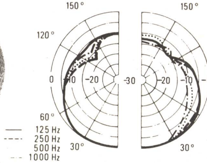
studio sound

Polar diagram:

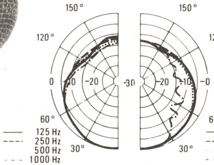
D 330 BT



D 320 B



D 310



No other "instrument" is more difficult to record or reproduce than the human voice. Each voice is the expression of a person's individuality, and conveys feelings and moods in an infinite variety of audible characteristics. AKG, who have specialised in the solution of difficult acoustical problems for many years, have released these new microphones which met the stringent requirements of modern day professional musicians and vocalists. The D300 Series incorporates various built-in protective features, because, as accidents do happen (and usually at the wrong time), microphones must be robust to guarantee continuing operation at a studio quality sound.

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- Excellent suppression of handling noise.
- Stainless steel wire mesh outer grille.
- Shockproof internal grille to protect transducer.

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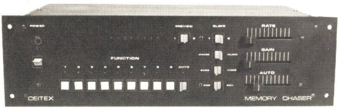
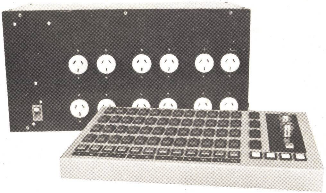
The total, modular, chaser effects system



This amazing new unit is an 8 channel chaser — with 8 Functions! Designed in a panel or rack mounting case, the Memory Chaser will chase, ripple, pulse, flip-flop, audio chase or just flash up to 20 amps total load. Functions include forward or reverse, audio increment, auto program change for "hands off operation", preview control for "off load" function viewing, and much much more. The Memory Chaser may be linked with any number of 8 channel, 20 amp slave units, allowing expansion where required. Power connection is into a terminal strip for the load, and through a single lead for the memory control. Lantern connection is direct into two terminal strips. Access to all connector strips and fuses is through a removable rear section, with all cable entries through knockouts on the rear of the unit. All things considered, there is very little that this amazing chaser won't do — ask about it NOW at any Barratt Lighting agent.

REMOTE LIGHTING CONTROL SYSTEM
Lighting Control for BANDS, DISCOS, CLUBS etc.

BY ACCESS ELECTRONICS



The reaction to the ACCESS ELECTRONICS Remote Swithcboard has left us breathless — not surprising when you consider what this wonderful innovation is capable of! It's a remote control switching system for up to 24,000 watts of lighting — 12 channels, each rated at 2000 watts per channel — and featuring zero switching for virtually no interference with audio equipment! The control desk features 4 PRESETS, each of 12 switches with LED indicators. Just select several scenes ahead, and switch in each preset where required. Or instant flash through the flash buttons — a built-in programmable sequencing chaser — flash buttons on the preset masters — and all in a neat, light, easy to use remote desk. A single 16-core multicore with multiway connectors connects the desk to the switching rack — no separate power supply is needed for the desk. The on-stage rack has 12 outlets, and a switch for each outlet, to allow quick load-testing or focusing on stage. Power requirement for the rack is usually 3-phase, 30 amps per phase, which is considered the industry standard. This system even switches inductive loads — things like strobes, chasers, hotspots, mirror balls — the applications are endless!

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FROM ROCK INDUSTRIES

COLOURWHEELS These hard-to-get continual colour change wheels are now available to suit Strand PATT 23 Spotlights and all Rock Industries hotspots and rainlights.

BARNDOORS Now achieve control over PAR 56 and PAR 64 beams — add a Barndoor! These 4-door shutters offer square edge control over fixed PAR beams, making the PAR 56 and PAR 64 spots into very versatile units. The Rock Industries Barndoor is a fraction of the cost of similar imported units.

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SOUND review

Kenwood KA-701 high speed, dc integrated amp

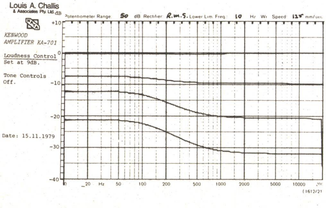
Does a 400 kHz bandwidth matter? Louis Challis says, "... this amplifier neither adds nor subtracts from (the programme) content, which is obviously what the designers intended."

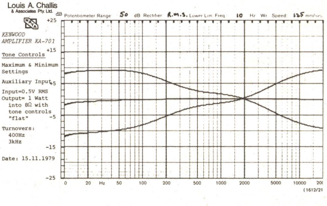
THE KENWOOD CORPORATION has had a reputation over the last few years of producing top-line amplifiers with the design emphasis being placed on dc-coupled circuitry having extended high frequency response and faster than normal rise time.

There are many people who argue that the extent to which an amplifier's frequency response is increased is of little interest if that response is outside the normal 20 Hz – 20 kHz bandwidth, conventionally accepted as being the limits for normal human hearing.

It is interesting that the antagonists and protagonists in this argument do not appear to be drawing closer together and the more strongly the antagonists argue, the greater the number of manufacturers who join the ranks of those offering high speed, fast rise time amplifiers. Kenwood were amongst the first in the field and the KA-701 is currently their top-of-the-line consumer model. Frankly, I for one used to consider myself well entrenched in the ranks of the antagonists, although it has always been clear to me that there were some merits in the protagonists' theories.

Some four years ago, or thereabouts, the work of Professor Matti Otala became well known through his writings in the journal of the A.E.S. Otala's efforts were devoted essentially to highlighting the dangers of transient intermodulation distortion (TIM). What Otala found was that even though the high frequency





signal degradation occurs at ultrasonic frequencies, the intermodulation products spread through the audible frequency band and result in components which you can readily hear.

Otala showed that TIM is controlled primarily by slew rate limits rather than amplitude limits. The greater the frequency bandwidth of the amplifier, the faster the slew rate — although the two are not necessarily directly related. Two amplifiers can have the same bandwidth but may well have significantly different slew rates.

Otala showed convincingly that amplifiers with faster slew rates generally produce less TIM. Kenwood was one of the manufacturers who were obviously convinced by these theories and proceed to design their new amplifiers on that basis.

Features

The KA-701 is an attractive amplifier. The normal version features a brushed-satin aluminium front escutcheon with walnut-veneered side panels, but a rack mounting version with optional carrying and lifting handles is also available.

The frontal layout is arranged with two horizontal rows of controls on both sides with a centrally located, unusually large, calibrated stepped attenuator. The controls on the left hand side of the amplifier are a speaker control for A and B and off; a toggle switch for power on/off; a tip-ring-and-sleeve headphone socket; bass and treble controls offering + 10dB of adjustment with turnover frequencies for the bass of 200 Hz, 400 Hz and defeat; and turnover frequencies for the treble of 3 kHz, 6 kHz and defeat. The volume control is directly calibrated in dB intervals with 4 dB steps from 70 to 46, 3 dB steps from 46 to 22, 2 dB steps from 22 to 10 and 1 dB steps from 10 to 0 attenuation. The controls on the right hand side of the escutcheon are -20 dB attenuator; an 8 kHz low-pass filter; a dc or ac amplifier coupling switch providing dc to 400 kHz or 18 Hz to 400 kHz bandwidth respectively; an input selector for auxiliary, tuner, phono 1 and phono 2 and a balance control; a loudness control offering three levels of low frequency bass equalisation at 50 Hz; a mode switch for stereo, mono and reverse; and a tape control switch offering source, recorder A to B, B mono, tape recorder A play source and tape recorder B play.

The rear of the amplifier features normal coaxial inputs for the two record players, two tape recorders, auxiliary and tuner; effective spring loaded terminals for two speaker systems; and two fuses for the speaker systems.

The inside of the amplifier is more exciting than the back for it features a large heatsink assembly in the centre, flanked by two separate power supplies at the rear, and a large, well-screened power transformer and preamplifiers. These are separated from the main amplifier with interconnection by means of ribbon cable to provide a neat, practical interconnection. The heatsink is significantly different from those used by other manufacturers to be worthy of comment for the stated 80 watts per channel rating is obviously directly dependent upon the dissipation rating of this heatsink. This is much more efficient than it looks, for it most certainly does the job.

Objectively

The objective testing of the amplifier showed it exhibited wide frequency response both in ac and dc mode, with the latter being a 'true dc response' whose implications the average audiophile would need to consider before risking blowing up his speakers.

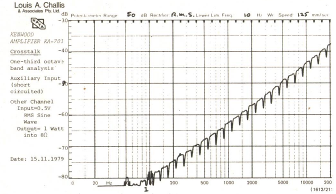
The sensitivities of the auxiliary, tuner and tape inputs are all round the 19-22 millivolt level while the phono input has a 330 microvolt input for 1 watt into eight ohms and a 256 millivolt overload point, which is excellent and very conservative.

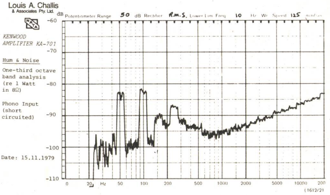
The distortion characteristics of the amplifier at the 80 watt level are extremely conservative, being less than 0.012% at 100 Hz, 1 kHz and 6.3 kHz, dropping to less than 0.003% at 1 kHz and 6.3 kHz with 1 watt into eight ohms. The measured TIM is less than 0.14% which is excellent but not the best performance we have seen, whilst the noise and hum levels are -85 dB(A) from the auxiliary input and -79 dB(A) from the photo input, both of which are particularly good.

The overload recovery of the amplifier is *exemplary* as is the channel crosstalk performance owing to the unit having two separate power supplies. The frequency response, in particular, offers one of the smoothest responses we have yet seen. In the range 10 Hz to 20 kHz the frequency response is essentially *as flat as you could ask.*

Subjectively

The subjective performance of the amplifier was equally pleasing. We ▶





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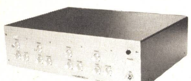

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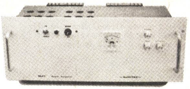

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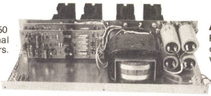

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evaluated the amplifier with a range of cartridges including moving-coil, moving-magnet, tape recorder and tuner inputs and various speakers. The amplifier did not appear to either add nor subtract from the original programme content and can only be described as *completely neutral.*

Whilst Trio-Kenwood do believe that a 400 kHz bandwidth is essential to achieve low TIM distortion I am not completely convinced that the results are necessarily subjectively superior. Putting it another way, I do not believe you lose anything by having the bandwidth and superlative slew rates that this amplifier can provide, but equally important I am not convinced that you gain all that much more either.

During the subjective evaluation I took the opportunity of listening to some new Sony CBS records, produced utilising a Sony digital recorder, in relation to the more conventional analogue recorders in the studio. Having heard the original digital tapes which created an impression of *being there*, I was not surprised when listening to the output of this amplifier that the self-same impression could be readily created with this amplifier.

The KA701 amplifier obviously provides a clean uncoloured output which is dependent upon the programme content and not the amplifier. During the objective and subjective phases of our evaluation it was apparent that this amplifier neither adds nor subtracts from that content which is obviously what the designers intended. The KA-701 amplifier is good and at the price recommended may not be cheap, but is undoubtedly well worth the money.

KENWOOD KA-701 HIGH SPEED DC INTEGRATED AMPLIFIER

Dimensions: 440mm x 153mm high x 407mm deep

Weight: 13.5kg *Price: $569*

Manufactured by: Trio-Kenwood Corporation, Tokyo, Japan

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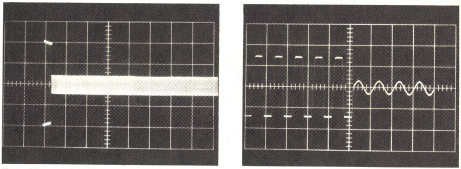
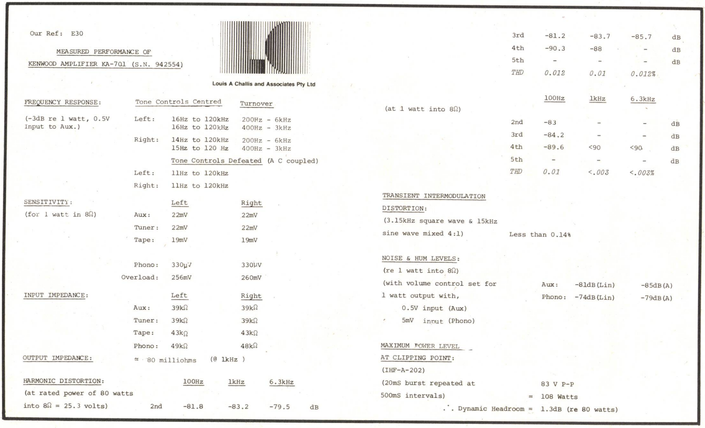


Transient overload recovery test: 10 dB overload re 80 W into 8 ohms, both channels driven; overload duration - 20 ms, repetition rate - 512 ms. Left photo at 50 ms/div, right pic at 1ms/div.



Our Ref: E30

MEASURED PERFORMANCE OF
KENWOOD AMPLIFIER KA-701 (S.N. 942554)

Louis A Challis and Associates Pty Ltd

FREQUENCY RESPONSE:
(-3dB re 1 watt, 0.5V Input to Aux.)

	Tone Controls Centred	Turnover
Left:	16Hz to 120kHz 16Hz to 120kHz	200Hz - 6kHz 400Hz - 3kHz
Right:	14Hz to 120kHz 15Hz to 120 Hz	200Hz - 6kHz 400Hz - 3kHz
	Tone Controls Defeated (A C coupled)	
Left:	11Hz to 120kHz	
Right:	11Hz to 120kHz	

SENSITIVITY:
(for 1 watt in 8Ω)

	Left	Right
Aux:	22mV	22mV
Tuner:	22mV	22mV
Tape:	19mV	19mV
Phono:	330μV	330μV
Overload:	256mV	260mV

INPUT IMPEDANCE:

	Left	Right
Aux:	39kΩ	39kΩ
Tuner:	39kΩ	39kΩ
Tape:	43kΩ	43kΩ
Phono:	49kΩ	48kΩ

OUTPUT IMPEDANCE: ≃ 80 milliohms (@ 1kHz)

HARMONIC DISTORTION:
(at rated power of 80 watts into 8Ω = 25.3 volts)

	100Hz	1kHz	6.3kHz	
2nd	-81.8	-83.2	-79.5	dB
3rd	-81.2	-83.7	-85.7	dB
4th	-90.3	-88	-	dB
5th	-	-	-	dB
THD	*0.012*	*0.01*	*0.012%*	

(at 1 watt into 8Ω)

	100Hz	1kHz	6.3kHz	
2nd	-83	-	-	dB
3rd	-84.2	-	-	dB
4th	-89.6	<90	<90	dB
5th	-	-	-	dB
THD	*0.01*	*<.003*	*<.003%*	

TRANSIENT INTERMODULATION DISTORTION:
(3.15kHz square wave & 15kHz sine wave mixed 4:1) Less than 0.14%

NOISE & HUM LEVELS:
(re 1 watt into 8Ω)
(with volume control set for 1 watt output with,
0.5V input (Aux)
5mV input (Phono)

Aux:	-81dB(Lin)	-85dB(A)
Phono:	-74dB(Lin)	-79dB(A)

MAXIMUM POWER LEVEL AT CLIPPING POINT:
(IHF-A-202)
(20mS burst repeated at 500mS intervals) 83 V P-P
= 108 Watts
∴ Dynamic Headroom = 1.3dB (re 80 watts)

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R83CS Cassette

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2. All have a cantilever assembly which is robust.
3. All have user replaceable stylus assemblies.

While all this may be music to your ears, the real Grado difference stems from the ability to overcome many of the electromechanical distortion products found in other modern cartridges (by the Flux Bridger Principle), and the ability to deliver correct tonal balance with its very extended top end and tight bass.

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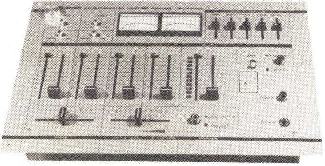

- Low Noise
- 4 Stereo Program Inputs
- 2 Microphone Inputs
- 5 Channel Stereo Equaliser
- Full Cueing Facility

SPECIFICATIONS

Input Sensitivity	MIC	0.5mV
	PHONO	3mV
	LINE	150mV
Input Impedance	MIC	10K ohms
	PHONO	50K ohms
	LINE	50K ohms
Maximum Input Level	MIC	45mV
	PHONO	140mV
	LINE	35V
Rated Output	AMP	1V
	REC	1V
Output Impedance	100 ohms	
Harmonic Distortion	At Rated Output 0.2% At 6V Output 0.3%	

Hum And Noise	MIC	-52dB
	PHONO	-62dB
	LINE	-65dB
Frequency Response	MIC	30 to 16000Hz (-1dB)
	PHONO	30 to 20000Hz (RIAA±2dB)
	LINE	20 to 30000Hz (-1dB)
Equaliser Section		
Control Frequencies	60Hz, 250Hz, 1kHz, 3.5kHz, 12kHz	
Control Range	±12dB, Boost or Cut	
Control Type	Slide Centre Detent for "Flat" setting	
Headphone Output (CUE)	50mW at 75 ohms at 0.5% THD	
Talk Switch	-14dB at Phono or Line at TALK Position	
Power Consumption	AC 220V 50/60Hz 8 Watts	
Dimensions	15.3" (W) x 3.7" (H) x 10.2" (D)	
Shipping Weight	9.3lb	

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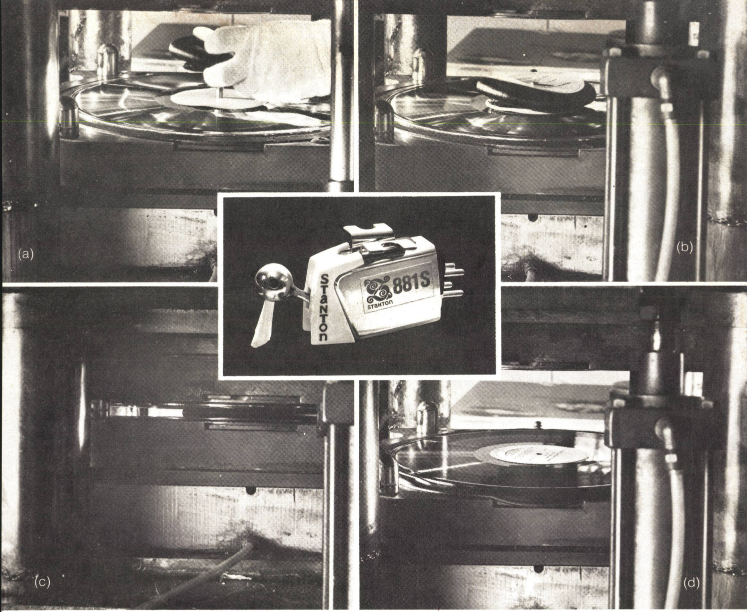

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SOUND review

Yamaha NS344 speakers

A three-way system of almost bookshelf size, Louis Challis found these Yamaha speakers provide "... excellent performance from a very reasonably sized package."

THE YAMAHA NS344 is a speaker system which can be loosely described as bordering on a bookcase-size system. I have always gained the impression that Yamaha bestow the same loving care on their main line of speakers as they do on their musical instruments as I have generally been equally impressed by both.

The NS344 is a system which maintains that fine tradition through an excellent design and fastiduous care with the details. This is a three-way system having a 250 mm diameter woofer, a 100 mm mid-range driver and a 24 mm diameter soft dome tweeter arranged in a linear array with the woofer at the bottom and the tweeter at the top. This configuration, as we all now know, provides the maximum dispersion and minimum phase cancellation in the lateral plane with the speakers arranged conventionally in a pair for good stereo imaging.

Features

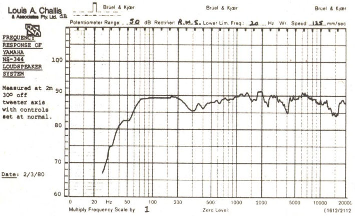
Both the mid-range speaker and the tweeter are provided with contour controls allowing both boost and cut for these drivers. The amount of boost that each is capable of providing is typically +6 dB whilst the amount of cut is quite selective. In the case of the mid-range this can amount to 30 dB of attentuation at 2 kHz, with an almost notch like response, whilst the tweeter controls provide approximately 30 dB of attentuation at 20 kHz. The crossover frequencies for the unit are arranged to occur at 400 Hz and 4 kHz and these crossover frequencies are well chosen to provide the best phase and frequency performance for this system.

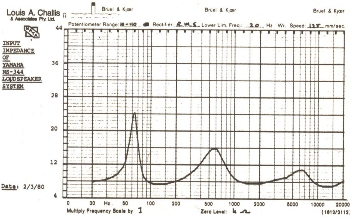
The cabinet in which the speakers are located in reasonably solid, although it does exhibit some noticeable resonance from the back. The latter is constructed from plain particle board with significantly different characteristics to the front and sides which are veneered and beautifully finished. The speaker grill cloth is acoustically transparent cloth stapled onto a wooden frame with plastic press studs, whilst the connections at the rear of the speaker are by means of spring-loaded wire retention sockets which are sensible and convenient.

On test

An objective testing of the NS344 speaker was initiated with the determination of the on-axis and off-axis responses in our anechoic room. This showed immediately that this speaker system is significantly better than average and offers an unusually flat response extening from 55 Hz to 20 kHz. Over that frequency range the maximum excursion is less than 6 dB and the only significant excursions occur at the bottom end of the between 4 kHz and 20 kHz, where the tweeter response on axis shows a deviation not exceeding 5 dB. A comparison of the composite graph with the on-axis frequency response of each of the drivers illustrate how well the Yamaha Company has succeeded with their design.

If the on-axis response is good, the off-axis response is even better and at +30° to the main axis the frequency response is excellent. By contrast, the mid-range and tweeter contour controls did terrible things to the frequency response. This is possibly to be expected from the tweeter control, but not to





the extent nor in the manner observed with the mid-range control. In general terms we would recommend that these controls should not be used as they do not do what any self respecting listener would ever expect.

We evaluated the phase response in the anechoic room and were gratified to see how really smooth this is. Whilst not the ultimate, we believe that most manufacturers would be delighted if their speakers achieved a phase response approaching that of the NS344 system.

The transient performance of the speaker is without question one of the best we have seen in many years. The tone burst responses at the standard test frequencies of 100 Hz, 1kHz and 6.3 kHz were exemplary and are a real credit to the manufacturer. The tone burst response at other frequencies was equally good and mirrors, as we subsequently found, the quality of reproduction on real programme content. The impedance curve shows three main response resonances, the lowest and dominant response being at 65 Hz with a modest peak of 200 Hz whilst the lowest impedance is seven ohms at typically three points within the operating range. The phase response of the speaker is also particularly smooth and it is quite apparent that the interaction of crossover networks and speakers has been carefully designed to maintain phase type configuration.

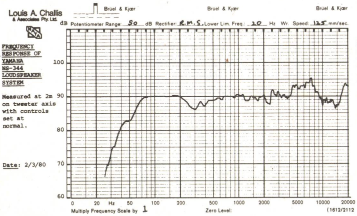
If we were impressed by the frequency response, phase response and tone burst response, we were even more impressed by the distortion figures produced by this speaker system. They are particularly low and round off a set of objective tests which are, in all respects, excellent.

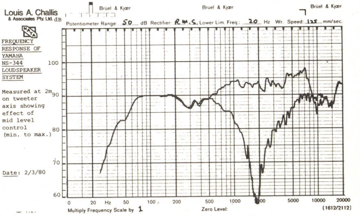
To the ear

The subjective impressions of this speaker are dominated by its clean undistorted sound at normal listening levels and lack of colouration on speech, guitar, tympany and such musical instruments as woodwind and harpsicord. On rock, the modest low frequency response and 50 Hz cutoff frequency did not project the sound as well as most other large speakers. On the other hand, classical music sounds exciting and the sound from "direct cut" records exhilerating.

We drove the speakers with a Yamaha D2200 Amplifier, without driving it to the maximum power level, and were more than surprised at the peak power levels that they could handle without fuss and bother. They took peaks of up to 100 watts in their stride, but noting the manufacturer's restriction on the back panel (of 70 watts input), we were not prepared to destroy them in our desire to evaluate their maximum power handling capacity!

▶





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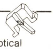
M95 SERIES	 **N95HE*** Hyperelliptical stylus
M70 SERIES	**N72EJ** Biradial (Elliptical) stylus **N72B** Spherical stylus
ANY M91, M92, M93	**N91ED*** stylus
ANY M71, M73, M75	**N75 TYPE 2*** Series styli
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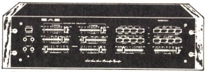

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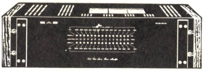

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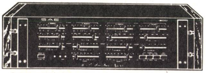

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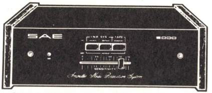

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Summary

The NS344 speaker system is not the first Yamaha speaker system we have evaluated, nor do we expect it to be the last. As long as Yamaha are able to produce loudspeaker systems with subjective and objective test results as good as these, they should have no difficulty in retaining their share of the market place. These speakers assure the intending purchaser of an excellent performance from a very reasonably sized package.

THE YAMAHA NS344 SPEAKER SYSTEM

Dimensions: 330mm wide x 570 high
x 312mm deep

Price: $575

Manufactured by: Nippon Gakki Company
Limited, Japan

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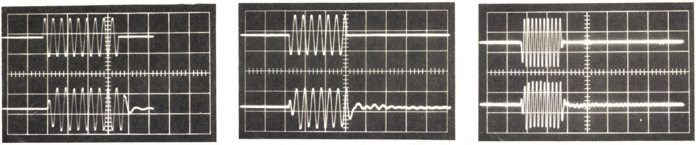
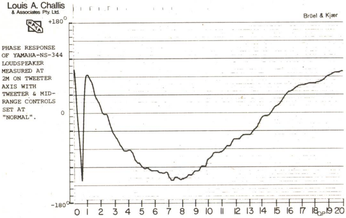
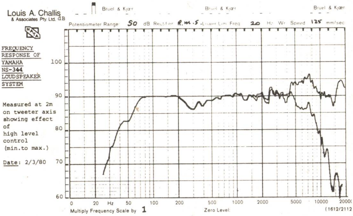


Tone burst response oscillograms for the Yamaha NS-344 loudspeakers. Results taken for 90 dB steady state SPL at 2m on axis. Picture at left is taken with tone of 100 Hz applied, pulse input on upper trace, speaker output on lower trace. Sweep set at 20 ms per div. Centre picture taken for 1 kHz tone, 2 ms/div. sweep speed. Picture at right is for 6.3 kHz, sweep speed 0.5 ms/div.



PHASE RESPONSE OF YAMAHA-NS-344 LOUDSPEAKER MEASURED AT 2M ON TWEETER AXIS WITH TWEETER & MID-RANGE CONTROLS SET AT "NORMAL".



FREQUENCY RESPONSE OF YAMAHA NS-344 LOUDSPEAKER SYSTEM

Measured at 2m on tweeter axis showing effect of high level control (min.to max.)

Date: 2/3/80

MEASURED PERFORMANCE OF

YAMAHA NS-344 LOUDSPEAKER SYSTEM SERIAL NO. L 102212

FREQUENCY RESPONSE: 60Hz - > 20kHz

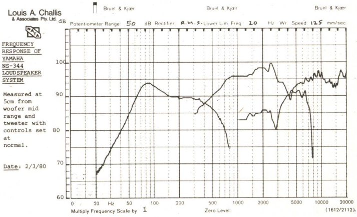
CROSSOVER FREQUENCIES: 600Hz and 2.5kHz

SENSITIVITY:
(for 90dB average at 2m) 7.1 VRMS = 6.3 Watts (nominal into 8Ω)

HARMONIC DISTORTION:		100Hz	1kHz	6.3kHz	
(for 90dB at 2m)	2nd	-53	-60	-49.7	dB
	3rd	-45	-56	-59	dB
	4th	-72	-75	-65.2	dB
	5th	-62	-72	-	dB
	THD	0.6 %	0.19 %	0.33 %	

INPUT IMPEDANCE:			
	100Hz	7	Ω
	1kHz	9	Ω
	6.3kHz	10.5	Ω
Minimum at	14kHz	6.8	Ω

Louis A Challis and Associates Pty Ltd



FREQUENCY RESPONSE OF YAMAHA NS-344 LOUDSPEAKER SYSTEM

Measured at 5cm from woofer mid range and tweeter with controls set at normal.

Date: 2/3/80

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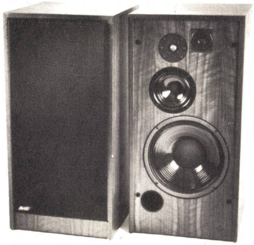

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Wharfedale E70 Four-way loudspeakers

Top of the line in their 'E' series speakers, this four-way system produces "... truly excellent bass performance".

AS LONG AS we can remember Wharfedale have always produced efficient speakers. Ten years ago the super 10's and 12's series were among the most efficient speakers available from any source.

Efficiency, however, is only a parameter among many by which you may separate the various characteristics of one speaker system when comparing it with another. Equally important are frequency linearity, lack of colouration and low distortion. Personally, we think that efficiency is of minor importance in evaluating a large speaker and that the other parameters are far more important. Wharfedale do not make many claims for the new 'E' series enclosures but they do claim that the E series makes 20 watts sound like 200. They also claim that they are "revolutionary", although we feel that this is the advertising agency's claim and not the designers.

Features

The E70 is the top line, and the largest model, of a trio of loudspeaker systems with fairly similar characteristics, the most significant being that the E70 is specified as having a 35 Hz bass cut-off frequency whilst the two lesser models have higher cut-off frequencies.

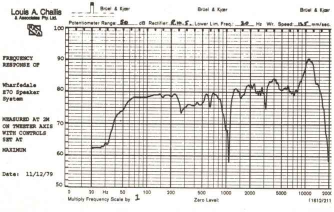
The E70 makes use of a 250 mm diameter woofer which is claimed to have low inertia, two 100 mm diameter mid-range drivers with conventional appearance and a 125 mm diameter horn loaded compression driven tweeter to cover the top end of the spectrum. These are installed in a fairly assymmetrical configuration which to some extent affects both the measured and audible interaction of the individual drivers on one another and possibly more significantly, on the frequency responses which we have measured in the anechoic room.

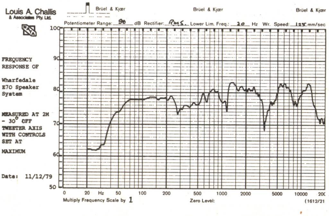
The crossover networks, cabinet design, and most particularly the venting for the cabinet enclosure, are computer designed and optimised for a maximally flat fourth-order Butterworth response. The cabinet has a volume of 70 litres, and unlike other manufacturers, incorporates an expanded polyurethane foam as a dampening medium in lieu of the more conventional fibreglass or bonded acetate type liners. The actual speaker drivers are all provided with fancy aluminium screw-in surround, as in the venting port at the bottom of the enclosures, for appearances sake rather than functionality. Between the base driver and the horn loaded compression driver there are two contour controls for the mid-range and tweeter, each with five positions offering a maximum five decibels of adjustment between 100 Hz and 1 kHz and a maximum of 15 dB adjustment between 115 kHz and 20 kHz. This adjustment is not linearly related to any frequency and may not quite be what the designers intended.

The speaker grille consists of a black acoustically transparent grille with the grille cloth retained by neat plastic clips and mating catches at the four corners of the enclosure. The appearance of the speaker grille and the cabinet is substantially improved on the previous generation of Wharfedales that we knew and this speaker does have a conventional appearance. The enclosure is provided with screw terminals angled close to the base at the rear of the enclosure. The enclosure itself is solid veneered particle board on the top, bottom and sides and black sprayed particle board on the front and rear.

On test

The objective testing of the unit showed that the frequency response extends





from 35 Hz to 18 kHz, +/− 10 dB. The frequency response of the 250 mm low frequency driver is particularly smooth, extending from approximately 40 Hz to 1 kHz. At the crossover and mid-frequency section there is a sharp frequency interaction that is evident directly on-axis, but not evident off-axis.

The mid-frequency section extends from just over 1 kHz to just over 3 kHz where, again, the interaction with the horn loaded compression driver produces a notch which is evident both on axis and very significantly off axis.

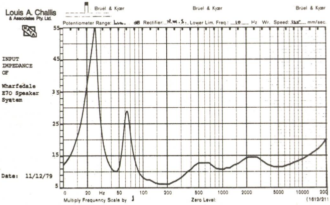
The top end response exhibits a pronounced peak between 8 kHz and 15 kHz and is a direct function of the directivity pattern of the horn loaded compression driver. The off-axis high frequency linearity is substantially smoother than the on-axis response and it is evident that the designers have done a reasonable job in balancing out the interactions between woofer, mid-range and tweeter elements of the system.

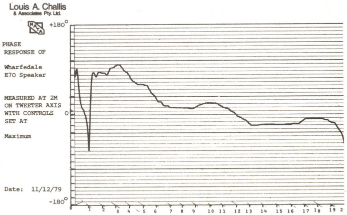
The contour controls provided affect the 200 Hz to 2 kHz range and the 2 kHz to 20 kHz range. The changes in the frequency linearity that they produce are not as smooth as we would like, with the maximum contouring ocurring at around 300 Hz for the bottom end control and around 4 kHz for the tweeter control.

Whilst it is possible that various purchasers may see fit to use these controls we would not recommend their use and suggest that they be left in their unattenuated position. The non-linearity of the frequency response can be clearly seen on the accompanying level recordings.

The impedance curve of the speaker shows two distinct peaks in the curve, the first being 55 ohms at 25 Hz while the second peak is 29 ohms at 63 Hz. By contrast, the lowest impedance produced by the speaker is 6 ohms between 150 Hz and 200 Hz and the correct specification for the speaker system in accordance with the IEC TC/29 recommendation would be to call this a 6 ohm speaker system.

The phase response is remarkably smooth, with a total of less than 180°. This excellent phase response comes primarily as a result of the well designed crossover network which is a minimum phase type network as you can clearly see. The tone burst responses of the speaker are quite good, although there is a slight trace of





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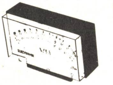

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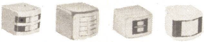

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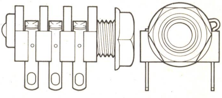
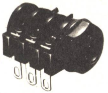
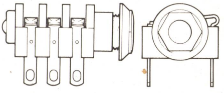
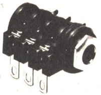




MONO

M100	Plastic fixing nut single : single
M101	Plastic fixing nut single : break
M102	Plastic fixing nut break : break
M120	Chrome fixing bush single : single
M121	Chrome fixing bush single : break
M123	Chrome fixing bush break : break





STEREO

M200	Plastic fixing nut single : single : single
M203	Plastic fixing nut break : break : break
M220	Chrome fixing bush single : single : single
M223	Chrome fixing bush break : break : break

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ringing at both 6.3 kHz and 1.2 kHz. We were unable to perform the tone burst response at 1 kHz, which corresponds to a crossover null frequency and would thus effect the transient response of the system. Even at 1.2 kHz, the frequency we chose, there was still some trace of ringing at a significant decrement on both the leading and trailing edges of the tone burst signal.

To the ear

We fed the speakers from a Kenwood KA701 integrated amplifier (reviewed this month) with content derived from some reel-to-reel tapes played from a Kudelski Nagra 4SJ recorder, cassettes fed from an Aiwa 6900 cassette deck and records played on a National Technics ST1200 with SME arm and V15 Era 4 cartridge, all of whose performance characteristics have been measured in the laboratory and whose subjective characteristics are also well known.

We compared the performance against a set of electrostatic reference speakers for mid-range and transient performance and a set of JBL studio monitors to evaluate the low frequency end of the spectrum on a comparative basis. The tapes were primarily sourced from IEC TC29/B Working Group 8, whilst the records were from the Swedish High Fidelity Institute, CBS/Sony Digital Tape Records and some excellent test records produced by JBL and Acoustic Research of America.

It was soon evident that the E70s have *a truly excellent bass performance* and the ability to handle high level rock music with only moderate distortion on all but the very lowest frequencies found in prerecorded content. One piece of music alone proved to be too tough and that was the test record produced by the Swedish High Fidelity Institute. Out of fairness however, it must be pointed out that there are only two speakers that we have ever reviewed that can cope with this particular vignette. Even so, the E70 provided a passable response and can be far better with the high level rock music and other transient content which we played through the system. The E70 sounds particularly good on guitar, classical and jazz but does not perform quite so well on spoken voice or on the real nasty hard rock.

It is my general impression that this speaker is more like an Altec Lansing or JBL than the classical British speakers which I have grown accustomed to hear.

Summary

The E70 is, without a doubt, the best Wharfedale system that I have yet heard and provides the sort of performance that could dramatically improve their listing in the Top 40 speaker ratings.

WHARFEDALE E70 FOUR-WAY LOUDSPEAKER SYSTEM

Dimensions:	*815mm high x 342mm wide x 360mm deep*
Weight:	*32Kgs.* *Price $889*
Manufactured by:	*Wharfedale, United Kingdom*

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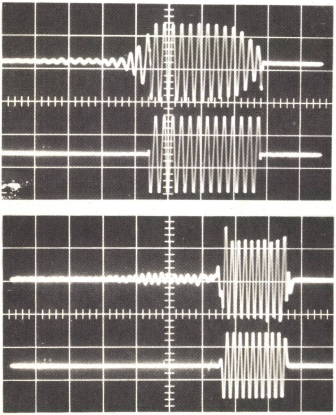
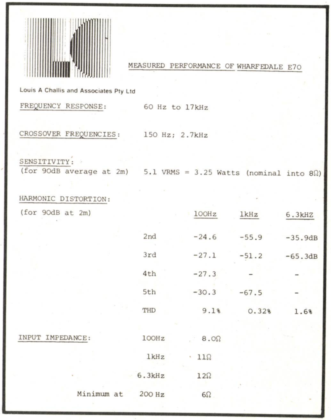


Tone burst response results for the Wharfedale E70s (for 90 dB steady state SPL at 2m on axis). Top photo shows 1.2 kHz burst (2 ms/div.), bottom shows 6.3 kHz burst (0.5 ms/div.).



MEASURED PERFORMANCE OF WHARFEDALE E70

Louis A Challis and Associates Pty Ltd

FREQUENCY RESPONSE: 60 Hz to 17kHz

CROSSOVER FREQUENCIES: 150 Hz; 2.7kHz

SENSITIVITY:
(for 90dB average at 2m) 5.1 VRMS = 3.25 Watts (nominal into 8Ω)

HARMONIC DISTORTION:
(for 90dB at 2m)

	100Hz	1kHz	6.3kHZ
2nd	-24.6	-55.9	-35.9dB
3rd	-27.1	-51.2	-65.3dB
4th	-27.3	-	-
5th	-30.3	-67.5	-
THD	9.1%	0.32%	1.6%

INPUT IMPEDANCE:

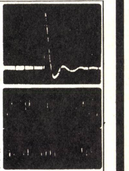
100Hz	8.0Ω
1kHz	11Ω
6.3kHz	12Ω
Minimum at 200 Hz	6Ω

The PCM age starts...

Are your speaker drivers ready for:

- extremely high dynamic range?
- very low harmonic and transient distortion?
- extremely high power handling, continous and transient?

D-28 Dome Tweeter	
Dynamic range:	better than 127 dB
DIN-power handling in system, crossover 4 KHz - 6 dB/oct.:	1.200 W
Transient power handling, tone burst 10 ms:	900 W
Rise time:	12 us
D-54 Dome Midrange	
Dynamic range:	better than 127 dB
DIN-power handling in system, crossover 800 Hz - 6 dB/oct.:	1.000 W
Transient power handling, tone burst 10 ms:	1.000 W
21 W-54 8 in Woofer	
Dynamic range:	better than 127 dB
DIN-power handling, depending on cabinet construction:	160-210 W
Transient power handling, tone burst 10 ms:	1.000 W
Free air resonance:	31-33 Hz



D-28: Transient response step function

D-54: Tone burst 2 kHz, 10ms-1.100 W.

We use hexagonal wire, ferro fluidics and DTL-system (dynamic transient linearity), pat. reg.: to improve rise time and to reduce IM distortion.

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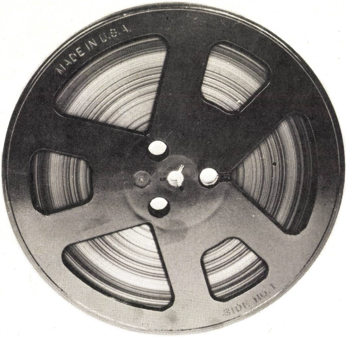

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Identical tapes to those offered are marketed in the USA by Ampex, using the trade name 'Shamrock'. This trade name is also used for those offered here.

NOTE: This offer is made by Dindy Marketing (Aust.) Pty Ltd and this publication is acting as a clearing house only. Cheques should be made payable to 'Ampex Tape Offer' and sent, together with the order form or accompanying letter, to 'Ampex Tape Offer', c/o ETI Magazine, 15 Boundary Street, Rushcutters Bay NSW 2011. We will then process your order and pass it on to Dindy, who will send you the goods. Please allow up to four weeks for delivery.

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AUDIO

WANTED: Any audio circuit diagrams for musical effects units, e.g. compressor, chorus, phaser etc. Write: G. Visontay, 14 Churchill Crescent, Cammeray, 2062.

MELBOURNE Hi-Fi and tape friends, the Recording Society of Australia meets monthly for demonstrations, lectures and live recordings. You are invited to come along for syllabus and information write or phone Don Patrick, 36 Argyle St., Macleod, 3085. (03) 459 1717.

SYNTHESISER: Wanted, ETI Synth. Any condition. Partially assembled or not working OK. Please write J. Jacobs 2/130 Roscoe St., Bondi Beach, 2026.

FOR SALE: JVC 5-band radio cassette recorder. Excellent condition. Tape counter. Many extras. $190. Phone (02) 85 0401. Anthony Hallam, 22 Grand Ave., West Ryde, 2114.

FOR SALE: Trio valve dual tuner/amplifier, old model, works perfectly. $40. Phone (02) 759 5080 Pat a.h., Lakemba, NSW.

WANTED: Any 2nd hand JBL professional series loudspeakers. Any Teac 3300, 3340 or 80.8 tape machines. Condition unimportant. 39 Chelsea Rd., Chelsea, 3196.

MICROPHONES (2): AKG D202ES dynamic, balanced output, extension cables, XLR connectors, microphone stands, $250. B. Bloom (051) 49 4111 ext 4629 (a.h.), ext 4420 (w.h.).

SELL: Realistic STA-52 AM/FM stereo amplifier/receiver perfect condition almost new. For further details and competitive price write or ring Mr. E. Montebello, 69 Geach St., Broadmeadows, 3047. Ph. 301 1625 w.h., 359 6726 a.h.

WANTED: Full service manual (buy or borrow) for Wattmaster Stereo (Dolby) Cassette Deck, Model CSD-2. Send details to B.D.Connors, 72 View Street, Gunnedah, NSW 2380.

LO-FI wind-up "Westonola" double width console. Play 78s properly. Stylish cabinet for electric stuff. Or room for both. Spare mechanisms. Rod Hibberd (02) 95 5873.

WANTED: Wiring diagram preferably from pcb to potentiometers for Toshiba 4 band solid state radio model RL-590RE. Thanks. Robin Sinko, Box 369, Renmark 5341 will pay.

COMMUNICATIONS

SELL: Galaxy V MK3 amateur transceiver 80-10 M in good condition with heavy duty p.s. $390. 3CH, MR3A carphone with Ch 37 & 40 $30, L. De Vries, VK3AXM, QTHR. Ph. b.h. 037842313, a.h. 059775977.

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AUSTRALIAN Radio DX club, for shortwave and mediumwave dxers. Monthly magazine published, write for details to ARDXC, P.O. Box 79, Narrabeen NSW 2101 enclosing a 30¢ stamp.

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OSI OWNERS: Let's start nationwide club, swap programs and ideas. Write P. Meulman, 4 Halsmere St., Geebung, Qld 4034. Ph. (07) 590017.

FOR SALE: 8085 with power supply 1k RAM 3 I/0 ports 1k monitor key pad 6 digit display working system in card cage, $110. Brian Laird, 8 Kilkenny Rd., Penrith, Ph. (047) 21 5333.

MICOM, Melbourne's Microcomputer Club meets on the third Saturday of each month at 2 p.m. at the A.M.R.A. Hall, Wills St., Glen Iris. Contact President, Steve Dart (03) 509 9729.

HP 33 E/C programs. Cubic and Quartic equations, artillery, Simpson's Rule, Newton's method and others. $3 each or exchange. David Billinghurst, P2 SMQ, Dampier, 6713.

ASR 33 for sale, excellent condition, sprocket feed 110 baud ASCII auto tape reader/punch 240 VAC, stand, remote start, $550. (02) 439 8002.

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SELL: EA 2650 fully buffered with I/0 8k RAM board. EA VDU kbd, case, p/s both 9/10 complete $400, Greg (02) 630-1013.

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SELL EA Feb-Apr 78 TV Typewriter/computer terminal, $160, slightly imperfect. B. Little, 7 Elmore Ave, Croydon 3136. Phone (03) 723 4277.

MISCELLANEOUS

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SELL: ETI-132 power supply. 0-16 V adjustable. Fully operational $55. Ph. R. Parkes, 796 8643 (a.h.), Clayton South, Victoria.

SELL: Elektor magazines No's 1-6, 9-26, 29, 31, 33-35, 42, 45, 47, 48. Total 33, lot $90. Phone Pat 759-5080 a.h. Lakemba, NSW.

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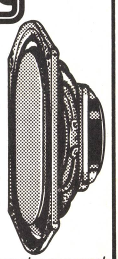

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SPECIFICATIONS

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7¼ Octaves A to C

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KITS for projects

WE GET MANY enquiries from readers wanting to know where they can get kits for the projects we publish. This list is a guide to suppliers of kits and components for ETI projects.

We have listed here most of the projects published over the last few years which are either available as kits or can still be made up by shopping around for components. Suppliers listed against a particular project will either stock it as a kit or stock the pc board plus the other components.

Printed circuit boards

Those suppliers listed against specific projects here are able to supply pc boards for those projects. Printed circuit boards for every project ever published in ETI are available through the following companies (to the best of our knowledge):

RCS Radio
651 Forest Rd
Bexley NSW

Radio Despatch Service
869 George St
Sydney NSW 2000

For current projects and a more comprehensive list of pc board suppliers refer to the Shoparound page in this and previous issues. This list will be updated roughly every four months.

Key to Companies

A Applied Technology Pty Ltd, 1A Paterson Avenue, Waitara, NSW 2077. Ph. (02) 487-2711.

B Bill Edge Electronic Agencies, 115 Parramatta Road, Concord (PO Box 1005, Burwood North 2134). Ph. (02) 747-6472.

C J.R. Components, PO Box 128, Eastwood, NSW 2122. Ph. (02) 85-3976.

D Dick Smith Electronics P/L, Cnr Waterloo & Lane Cove Roads, North Ryde, 2113. Ph. (02) 888-3200.

E All Electronic Components, 118 Lonsdale Street, Melbourne, Vic 3000. Ph. (03) 662-3506.

F Tasman Electronics, 12 Victoria Street, Coburg, Vic 3058. Ph. (03) 354-5062.

J Jaycar Pty Ltd, PO Box K39, Haymarket, NSW 2000. Ph. (02) 211-5077.

K S M Electronics, 10 Stafford Court, Doncaster East, Vic 3109. Ph. (03) 842-3950.

L Ellistronics, 289 Latrobe Street, Melbourne, Vic 3000. Ph. (03) 602-3282.

M Mode Electronics, PO Box 365, Mascot, NSW 2020. Ph. (02) 666-6324.

N Nebula Electronics Pty Ltd, 15 Boundary Street, Rushcutters Bay, NSW 2011. Ph. (02) 33-5850.

O Orbit Electronics, PO Box 7176, Auckland, New Zealand.

P Pre-Pak Electronics, 718 Parramatta Road, Croydon, NSW 2132. Ph. (02) 797-6144.

R Rod Irving, PO Box 135, Northcote, Vic 3070. Ph. (03) 489-8131.

V Silicon Valley, 23 Chandos Street, St. Leonards, NSW 2065. Ph. (02) 439-4655.

W Willis Electronics, 993 Hay Street, Perth, WA 6000. Ph. (09) 321-7609.

Y Trilogy, 40 Princes Highway, Fairy Meadow, NSW 2519

Project Electronics

041	Continuity Tester	W,R,D,B,Y,L
042	Soil Moisture Indicator	R,B
043	Heads or Tails Circuit (Oct 76)	W,R,D,E,A,F,B,Y,L
044	Two Tone Door Bell (Oct 76)	W,R,D,E,O,A,F,B,Y,L
045	500 Second Timer	W,D,E,A,B,Y,L
047	Morse Practice Set	W,D,O,A,B,Y,L
048	Buzz Board	W,D,A,B,Y,L
061	Simple Amplifier (Oct 76)	W,R,D,E,A,B,Y,L
062	Simple AM Tuner (Mar 77)	W,D,E,B,Y
063	Electronic Bongos	R,D,A,B,Y,L
064	Simple Intercom (Nov 76)	W,A,
065	Electronic Siren	W,R,D,E,O,A,B,Y,L
066	Temperature Alarm (Dec 76)	W,D,E,A,B,Y,L
067	Singing Moisture Meter	D,B,Y
068	LED Dice Circuit (Oct 76)	W,R,D,E,A,B,L
070	Electronic Tie Breaker (Jan 77)	
071	Tape Noise Limiter (Jun 78)	R,E,F
072	Two-Octave Organ (Jun 78)	W,D,B,Y
081	Tachometer (Mar 77)	W,E,O
082/ 528	Intruder Alarm	W,R,E,A
083	Train Controller	W,R,E,L
084	Car Alarm	W,R,D,E,A,B,Y,L
085	Over-rev Alarm	W
086	FM Antenna	W
087	Over-LED	W,E
088	Hi-Fi Speaker	W

Test Equipment

132	Experimenter's Power Supply (Feb 77)	E,O
133	Phase Meter (Apr 77)	E
134	True RMS Voltmeter (Aug77)	E
135	Digital Panel Meter (Oct 77)	E
136	Linear Scale Capacitance Meter (Mar 78)	
137	Audio Oscillator (May 78)	W,D,E
138	Audio Wattmeter (Nov 78)	E,B
139	SWR/Power Meter (May 78)	
140	1GHz Frequency Meter-timer (Mar 78)	C
141	Logic Trigger (Jan 79)	E
142	High Current Power Supply (Feb 79)	W,E
143	Curve Tracer (Jan 79)	W
144	Expanded-scale RMS Voltmeter (Jun 79)	E
148	Versatile Logic Test Probe (Jul 79)	E,L

Simple Projects

244	Alarm Alarm (Feb 77)	F
245	White Line Follower (Nov 77)	F
246	Rain Alarm (Apr 78)	F
248	Simple 12V to 22V Converter (Jul 78)	W
249	Electronic Combination Lock (Apr 79)	E
252	The Passionmeter (Aug 79)	
253	Electronic Grenade (Hot Potato) (May 79)	
254	Egg Timer (Jun 79)	W

Motorists' Projects

316	Transistor Assisted Ignition (May 77)	W,E,O,K
317	Rev. Monitor Counter (Jul 77)	E
318	Digital Car Tacho (Jul 78)	W,E,K
319	Variwiper MK II (Sep 78)	W,E,O
320	Battery Condition Indicator (Apr 79)	E,L

Audio Projects

448	Disco Mixer (Nov 76)	W
449	Balanced Microphone Amp (Nov 76)	W,D,E,J,F,Y
450	Bucket Brigade Audio Delay Line (Dec 77)	W,E
451	Hum Filter (Jul 79)	D,E,F
455	Class A Headphone Amp (Nov 78)	
470	60 W Amp Module (May 79)	W,R,E,F,B,P,L,A,V
471	High Performance Stereo Preamp Control Unit (Jun 79)	W,R,E,F,B,P,A,V,L
472	Power Supply — the Series 4000 Stereo Amp (Jul 79)	W,R,E,F,B,A,V,L
473	Series 4000 Moving-coil Cartridge Preamplifier	F,J
480	50-100 Watt Amp Modules (Dec 76)	W,R,D,E,J,O,A,Y,L
481	12V 100 Watt Audio Amp (May 77)	R,E
481	High Power PA/Guitar Amp (Jun 77)	W
482	Stereo Amp (Jan 77)	O,E
482	Stereo Amp Part 2 (Feb 77)	O,E
483	Sound Level Meter (Feb 78)	E
484	Simple Compressor Expander (Jul 77)	E,A
485	Graphic Equaliser (Jun 77)	W,E,J,O
486	Howl-round Stabiliser (Nov 77)	J
487	Audio Spectrum Analyser (Feb 78)	E
489	Audio Spectrum Analyser 2 (Apr 78)	E,J
490	Audio Compressor (Dec 78)	
491	Simple Graphic Equaliser (Mar 79)	W,E

Miscellaneous

546	GSR Monitor (Mar 77)	W,E
547	Telephone Bell Extender (Jun 77)	E
548	Photographic Strobe (May 77)	W,E
549	Induction Balance Metal Detector (May 77)	W,D,E,L
550	Digital Dial (Aug 78)	E,O
551	Light Chaser (Sep 78)	W,E,O
552	LED Pendant (Sep 78)	A
553	Tape/Slide Synchroniser (Oct 78)	E
556	Wind Speed/Direction Indicator (Dec 78)	
557	Reaction Timer (Feb 79)	E
558	Mast-head Strobe (Feb 79)	E
559	Cable Tester (Mar 79)	
575	Portable Fluorescent Light Wand for Car, Camping (Aug 79)	W
577	General Purpose Power Supply	J
581	Dual Power Supply (Jan 77)	W,E,Y
582	House Alarm (Jul 77)	W,E,O,A,
	House Alarm — Installation Instructions (Aug 77)	W
583	Marine Gas Alarm (Aug 77)	D,E,M
585	Ultrasonic Switch (Sep 77)	R,D,E,O,F
586	Shutter Speed Timer (Oct 77)	E
587	UFO Detector (May 78)	
588	Theatrical Lighting Controller (Nov & Dec 77 Jan & Mar 78)	N
589	Digital Temperature Meter (PCB135) (Dec 77)	E
590	LCD Stopwatch (Oct 78)	O,N
591	Up/Down Presettable Counter (Jul 78)	D,E
592	Light Show Controller (Aug 78)	E
593	Colour Sequencer (Dec 78)	
594	Development Timer (Apr 79)	E
595	Aquarium Lamp Controller (May 79)	

Electronic Music

602	Mini Organ (Aug 76)	W,D,E,A
603	Sequencer (Aug 77)	W
604	Accentuated Beat Metronome (Sep 77)	E

Computer Projects

630	Hex Display (Dec 76)	E,A
631	ASCII Keyboard (Dec 76)	W,E,O,A
631	Keyboard Encoder (Apr 77)	W,E,O,A
632	Video Display Unit (Jan 77)	E,O,A
633	TV Sync Generator (Jan 77)	E,A
635	Microcomputer Power Supply (Sep 77)	O
637	Cuts Cassette Interface (Jun 78)	V,E,A
638	Eprom Programmer (Jul 78)	W,E,A
639	Computerised Musical Doorbell (Mar 78)	A
640	S100 VDU (Apr, May, Jun 78)	W,O,A,V
641	S100 Printer (Sep 78)	O
642	16k S100 RAM Card (Feb 79)	K
650	STAC Timer (Nov 78)	E,A,L
651	Binary to Hex Number Converter (Jun 79)	E

Radio Projects

712	CB Power Supply (Jun 77)	W,E
713	Add-on FM Tuner (Sep 77)	
714	VHF-Log-Periodic Antenna (Feb, Mar 78)	
717	Crosshatch Generator (May 78)	W,D,E,A,Y
718	SW Radio (Oct 78)	E
719	RF Field Strength Indicator (Nov 78)	
720	2m VMOS Power Amp (Jan 79)	
721	Aircraft Band Converter (Mar 79)	W,E
724	Microwave Oven Leak Detector (Jul 79)	D,E,B
725	Simple SSB Generator employs Polyphase Network using Standard Components (Aug 79)	E,L
730	Get Going on Radioteletype (Aug 79)	E,L

Electronic Games

804	Selectagame (Nov 76)	O
804	Selectagame (Rifle Project) (Mar 77)	O
806	Skeet (Jan 78)	O
810	Stunt Cycle TV Game (Jun 78)	D,O
811	TV Tank Game (Oct 78)	O
812	Wheel of Fortune (Dec 78)	
813	Race Track Game (Jan 79)	O
814	The 'Dinky-Die' (Aug 79)	

eti

Editor
Roger Harrison VK2ZTB
Project Manager
Phil Wait VK2ZZQ
Editorial Staff
Roberta Kennedy
Jonathan Scott VK2YBN
David Tilbrook VK2YMI
Jan Vernon

Art Direction and technical photography
Ivy Hansen
Layout
Bill Crump
Reader Services
Jan Collins
Managing Editor
Collyn Rivers
Acoustical Consultants
Louis Challis & Associates
Editorial and Sales Office
4th Floor, 15 Boundary St
Rushcutters Bay NSW 2011
Ph: 33-4282; Tlx: 27243

Sales Manager: **Bob Taylor**
Sales Admin: **Jan Collins**
(address as above)

Melbourne
Tom Bray
150 Lonsdale St
Melbourne Vic 3000
Ph: 662-1222; Tlx AA34543

Adelaide
Admedia Group
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Ph: 322-3184; Tlx: AA93810

Auckland
Geoff Collins
Catalyst Ltd
Cnr, Pauls & Airedale Sts
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Ph: 79-4168

London
Australian Consolidated Press
Ludgate House
107 Fleet St
London EC4A 2AL
Ph: 353-1040; Tlx: 267163

Tokyo
Genzo Uchida
Bancho Media Services
15 Sanyeicho
Shin juku-Ku
Tokyo 160
Ph: 359-8866
Cable: Elbanchorito

New York
George McGann
Australian Consolidated Press
444 Madison Avenue
New York NY 10022
Ph: 751-3383; Tlx: 620892

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READER ENQUIRIES

By Mail: There is no charge for replies but a foolscap-size stamped addressed envelope **must** be enclosed. Queries relating to projects can **only** be answered if related to the item as published. We cannot advise on modifications to projects, other than errata or addenda, nor if a project has been modified or if components are otherwise than specified. We try to answer letters as soon as possible. Difficult questions may take time to answer.

By phone: We can only answer readers technical enquiries by telephone after 4 pm. In enquiring by telephone about back issues or photostats, please ask for the "Subscriptions Department". **33-4282**

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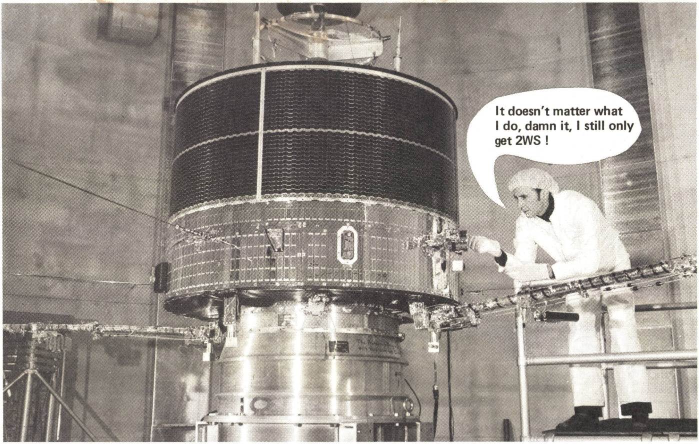
It doesn't matter what I do, damn it, I still only get 2WS !

DREGS

WE RECENTLY heard about a young university student who had been a keen electronics hobbyist since he was knee-high to a 6CA7. Apart from building the usual crystal sets, hee-haw sirens, home burglar alarms etc, he was a keen listener on the shortwave bands.

After some years doing quite nicely thank you at his philosophy course at the university, he felt the need to do something a little more substantial with his hobby. He threw himself wholeheartedly into studying for his amateur radio licence.

Unfortunately, after some time he had to postpone sitting for his amateur licence exam as his Professor said his extracurricular activities were interfering with his university studies.

The poor lad had to put Descartes before the Morse!

Random communications

Radio and electronics engineers normally feel that their science covers almost all fields of communications, including fibre optics and any voice communications other than those directly from one person to another. What other forms of communication are possible? Let us look at some exotic techniques.

Neutrinos can travel through matter virtually unhindered. A neutrino beam generated in England could easily travel through the earth to reach Australia. As neutrinos have a zero rest mass, they travel at the speed of light and will pass through the earth in under 1/20th of a second. Radio waves cannot pass through the earth and therefore expensive satellites in geostationary orbits are used in communications between widely spaced parts of the earth's surface. Why not use neutrinos? One can generate neutrinos in large numbers, but the problem is in detecting them at their destination. Although neutrinos can be detected, complex equipment is needed and the fraction of the neutrinos detected is very small indeed.

Neutrinos are unaffected by electric or by magnetic fields; they travel in straight lines except in so far as they are moved by the gravitational fields present in space. It has been suggested that very advanced civilisations may be using neutrinos to communicate rather than microwaves, so perhaps we are looking with the wrong equipment in our searches for extra-terrestrial neutrinos.

Even more exotic would be a communications system employing gravitational waves. Some years ago it was thought that these waves had been detected from astronomical sources, but this work has not been confirmed by other workers. Gravitational waves may offer some attractions for communications purposes, but until we can detect them, we cannot take the matter further.

Yet farther into the realms of fantasy, we can imagine communications by means of tachyons — hypothetical particles which can travel faster than light and which would therefore offer great speed advantages for communications with distant parts of the universe. Perhaps some being somewhere has discovered tachyons and is trying to use them to communicate with us!

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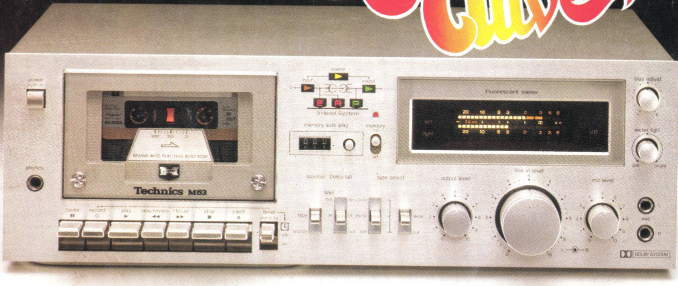

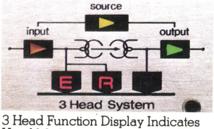

3 Head Function Display Indicates Head Mode.

For further information contact
the Technics Advisory Service
P.O. Box 319, North Ryde 2113.

Metal recording tape has arrived and so has the 3-head deck to handle it: Technics RS-M63 with new improved HPF* heads.

Metal tape offers the 'best yet' recording and playback quality. The dynamic range is much wider and frequency response extends much further into the high range than is possible with other tape types.

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